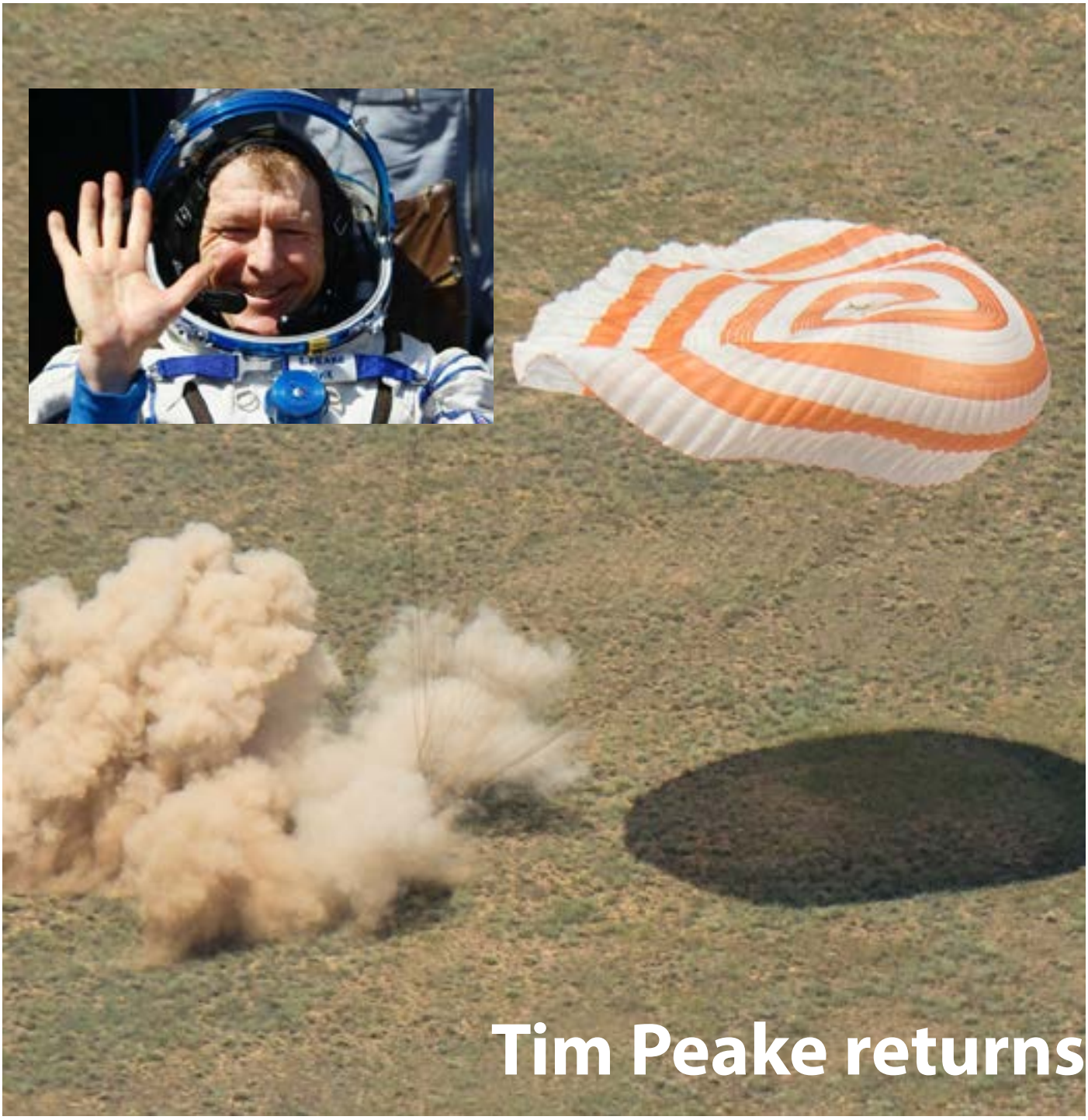
your window to space

capcom

Volume 26 Number 6 July/August 2016



Tim Peake returns

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

Three Space Station Crew Members Return to Earth, Land Safely in Kazakhstan

Three crew members from the International Space Station returned to Earth at 10:15 am BST on Saturday 18 June after wrapping up 186 days in space and several NASA research studies in human health.

Expedition 47 Commander Tim Kopra of NASA, flight engineer Tim Peake of ESA (European Space Agency) and Soyuz Commander Yuri Malenchenko of Roscosmos touched down southeast of the remote town of Dzhezkazgan in Kazakhstan.

The crew completed the in-flight portion of NASA human research studies in ocular health, cognition, salivary markers and microbiome. From the potential development of vaccines, to data that could be relevant in the treatment of patients suffering from ocular diseases, such as glaucoma, the research will help NASA prepare for human long-duration exploration while also benefiting people on Earth.

The three crew members also welcomed four cargo spacecraft, including one that delivered the Bigelow Expandable Activity Module (BEAM), an expandable habitat technology demonstration. The BEAM, which arrived in April on the eighth SpaceX commercial resupply mission, was attached to the space station and expanded to its full size for analysis over the next two years. The BEAM is an example of NASA's increased commitment to partnering with industry to enable the growth of commercial space, and is co-sponsored by the agency's Advanced Exploration Systems Division and Bigelow Aerospace.

Two Russian Progress cargo craft docked to the station in December and April, bringing tons of supplies. Kopra and Peake also led the grapple of Orbital ATK's Cygnus spacecraft to the station in March, the company's fourth commercial resupply mission, and the SpaceX Dragon spacecraft in April.

During his time on the orbital complex, Kopra ventured outside for two spacewalks. The objective of the first spacewalk was to move the station's mobile transporter rail car to a secure position. On the second spacewalk, Kopra and Peake replaced a failed voltage regulator to restore power to one of the station's eight power channels. Kopra now has 244 days in space on two flights, while Peake spent 186 days in space on this, his first, mission.

Having completed his sixth mission, Malenchenko now has spent 828 cumulative days in space, making him second on the all-time list behind Russian cosmonaut Gennady Padalka.

Expedition 48 continues on the station, with NASA astronaut Jeff Williams in command, with crewmates Oleg Skripochka and Alexey Ovchinin of the Russian space agency Roscosmos. The three-person crew will operate the station for three weeks until the arrival of three new crew members.

NASA astronaut Kate Rubins, Russian cosmonaut Anatoly Ivanishin and Takuya Onishi of the Japan Aerospace Exploration Agency are scheduled to launch on 6 July from Baikonur, Kazakhstan.

Alexander Gerst To Be Space Station Commander

ESA astronaut Alexander Gerst has been assigned a new mission to the International Space Station, where he will fulfil the role of commander during the second part of his six-month mission in 2018.

The news was announced on 18 May in the presence of German Chancellor Angela Merkel by ESA Director General Jan Woerner at the European Astronaut Centre in Cologne, Germany.

Alexander worked on the Station for six months on his Blue Dot mission in 2014. The German astronaut commented:

"I am humbled by receiving the honour to command the International Space Station. This international sign of trust reflects ESA's reliability as a cooperation partner, and was made possible by the fantastic work of my European colleagues on their previous missions. I am delighted by the prospect of continuing the scientific work that has been conducted on the ISS for many years. I am particularly looking forward to contributing to one of humanity's greatest exploration adventures: discovering new horizons.

Alexander's mission will continue the programme of research that often spans multiple missions. His second flight will likely see Alexander working with ESA's Mares muscle measurement machine, researching plasma crystals in weightlessness, and testing new technologies to support ESA's human exploration programme, in addition to the experiments of Station partners.

This is the second time a European astronaut will be commander of the Station in the 15 years it has been occupied – the first was Frank De Winne in 2009. Now heading the European Astronaut Centre, Frank noted, "Alexander showed outstanding performance, high professionalism and excellent interaction skills during his Blue Dot mission.

Alexander's second mission will run from May to November 2018 as part of Expeditions 56 and 57. He will be commander during the second part of his stay, during Expedition 57.

Alexander joined the ESA astronaut corps in 2009 and was assigned his first mission in 2011. He was awarded Germany's Order of Merit on return from his 166 days in space in 2014.

European Space Agency
http://www.esa.int - http://alexandergerst.esa.int/
Alexander Gerst's personal homepage
http://planet3.de/

European Space Agency astronaut Alexander Gerst aboard the ISS in 2014

NASA TV
www.nasa.gov

NASA Uploads App for Apple TV

Apple TV? There's a NASA app for that.

NASA has released its popular NASA app for a new platform, the fourth-generation Apple TV. This version joins the app's other versions available for iOS in iPhone and iPad versions, Android and Fire OS. The NASA app has been downloaded more than 17 million times across all platforms.

"The NASA app has been a fantastic way for the public to experience the excitement of space exploration from their mobile devices," said David Weaver, NASA associate administrator for Communications. "Now, users with the latest Apple TV can explore and enjoy our remarkable images, videos, mission information, NASA Television and more on the big screen with the whole family."

The NASA app for Apple TV offers several features for users:

- Watch live streaming NASA TV, and get a real-time view of the Earth from the International Space Station
- View more than 15,000 images individually or as a continuous slideshow
- Play on demand NASA videos
- Find the next opportunity to view the International Space Station and other NASA satellites pass overhead, based on your location.
- Display 2-D and 3-D satellite tracking maps
- Discover the latest NASA mission information
- Listen to Third Rock internet streaming radio
- View the Earth as Art image gallery

The NASA app is available for free in the App Store on Apple TV.

NASA
www.nasa.gov

Planetary Resources Earth Observation System

An asteroid mining company has raised money for an Earth observation system. Planetary Resources announced Thursday it raised a Series A round of $21 million that will fund development of Ceres, a system of 10 satellites that will provide infrared and hyperspectral observations of the Earth. The company said the imagery will support a number of markets, including agriculture and natural resources, and the technology is applicable to its long-term plans to prospect and mine asteroids. Planetary Resources also announced it was cancelling a crowdfunded project to develop a satellite for education and public outreach, and will be refunding the $1.5 million it raised from more than 17,000 people in 2013.

www.spacenews.com
www.planetaryresources.com

SpaceX Falcon 9 launches from Cape Canaveral; landing unsuccessful

Florida Today repoerts that SpaceX successfully launched its Falcon 9 rocket at 10:29 a.m. from Cape Canaveral Air Force Station on a mission to deliver two communications satellites to orbit. However the planned experimental landing of the first stage on an ocean barge was not successful this time.

SpaceX Could Face $15,000 Port Fees

SpaceX could have to pay port fees of up to $15,000 for each Falcon 9 booster it returns to Port Canaveral. The proposed fee, to be considered at a Canaveral Port Authority meeting this week, is intended to cover the costs to the port of handling the stage, which is returned to port on SpaceX's autonomous spaceport drone ship after the stage lands at sea. SpaceX opposes the proposal, arguing that the fee is 14 times higher than what any other user of the port is charged for using its facilities.

Florida Today via Space News
www.floridatoday.com www.spacenews.comw

Ariane 5 Delivers Its Heaviest Commercial Payload

On its third mission this year, Ariane 5 lofted more than 10.7 tonnes – its heaviest commercial cargo so far.

Liftoff occurred at 22:39 BST from Europe's Spaceport in Kourou, French Guiana to deliver the EchoStar-18 and BRIsat commercial satellites into their planned orbits.

EchoStar-18, weighing 6300 kg at liftoff and mounted in the upper position atop Ariane's Sylda dual-payload carrier inside the fairing, was the first to be released about 29 minutes into the mission.

Following a series of burns controlled by Ariane's onboard computer, the Sylda structure encasing the 3540 kg BRIsat was then jettisoned. BRIsat was released into its own transfer orbit about 13 minutes after the first satellite.

EchoStar-18 is owned and operated by Dish Network. Positioned at 110ºW in geostationary orbit, it will provide direct-to-home television broadcast services over North America.

BRIsat is owned and operated by Bank Rakyat Indonesia. Positioned at 150.5ºE in geostationary orbit, it will support banking services provided by this large Indonesian bank.

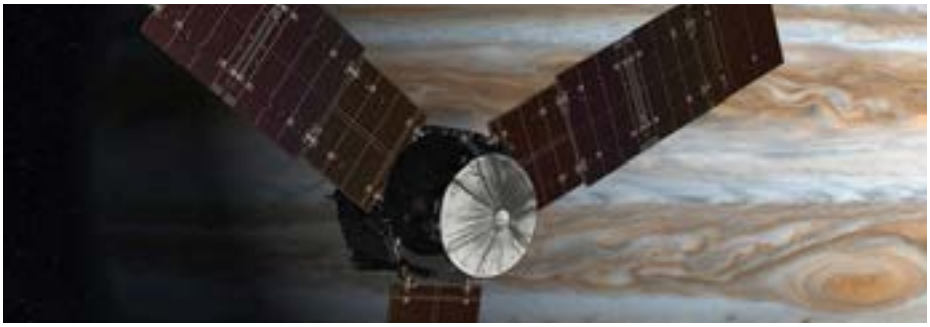
Both satellites have a design life of 15 years.

The payload mass for this launch was 10 731 kg. The satellites totalled about 9840 kg, with payload adapters and carrying structures making up the rest.

Flight VA230 was the 86th Ariane 5 mission.

ESA
www.esa.int

NASA's Juno Spacecraft in Orbit Around Mighty Jupiter



After an almost five-year journey to the solar system's largest planet, NASA's Juno spacecraft successfully entered Jupiter's orbit during a 35-minute engine burn. Confirmation that the burn had completed was received on Earth at 8:53 p.m. PDT (11:53 p.m. EDT) Monday, July 4.

"Independence Day always is something to celebrate, but today we can add to America's birthday another reason to cheer -- Juno is at Jupiter," said NASA administrator Charlie Bolden. "And what is more American than a NASA mission going boldly where no spacecraft has gone before? With Juno, we will investigate the unknowns of Jupiter's massive radiation belts to delve deep into not only the planet's interior, but into how Jupiter was born and how our entire solar system evolved."

Confirmation of a successful orbit insertion was received from Juno tracking data monitored at the navigation facility at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, as well as at the Lockheed Martin Juno operations center in Littleton, Colorado. The telemetry and tracking data were received by NASA's Deep Space Network antennas in Goldstone, California, and Canberra, Australia.

"This is the one time I don't mind being stuck in a windowless room on the night of the 4th of July," said Scott Bolton, principal investigator of Juno from Southwest Research Institute in San Antonio. "The mission team did great. The spacecraft did great. We are looking great. It's a great day."

Preplanned events leading up to the orbital insertion engine burn included changing the spacecraft's attitude to point the main engine in the desired direction and then increasing the spacecraft's rotation rate from 2 to 5 revolutions per minute (RPM) to help stabilize it..

The burn of Juno's 645-Newton Leros-1b main engine began on time at 8:18 p.m. PDT (11:18 p.m. EDT), decreasing the spacecraft's velocity by 1,212 miles per hour (542 meters per second) and allowing Juno to be captured in orbit around Jupiter. Soon after the burn was completed, Juno turned so that the sun's rays could once again reach the 18,698 individual solar cells that give Juno its energy.

"The spacecraft worked perfectly, which is always nice when you're driving a vehicle with 1.7 billion miles on the odometer," said Rick Nybakken, Juno project manager from JPL. "Jupiter orbit insertion was a big step and the most challenging remaining in our mission plan, but there are others that have to occur before we can give the science team the mission they are looking for."

Over the next few months, Juno's mission and science teams will perform final testing on the spacecraft's subsystems, final calibration of science instruments and some science collection.

"Our official science collection phase begins in October, but we've figured out a way to collect data a lot earlier than that," said Bolton. "Which when you're talking about the single biggest planetary body in the solar system is a really good thing. There is a lot to see and do here."

Juno's principal goal is to understand the origin and evolution of Jupiter. With its suite of nine science instruments, Juno will investigate the existence of a solid planetary core, map Jupiter's intense magnetic field, measure the amount of water and ammonia in the deep atmosphere, and observe the planet's auroras. The mission also will let us take a giant step forward in our understanding of how giant planets form and the role these titans played in putting together the rest of the solar system. As our primary example of a giant planet, Jupiter also can provide critical knowledge for understanding the planetary systems being discovered around other stars.

The Juno spacecraft launched on 5 August 2011 from Cape Canaveral Air Force Station in Florida. JPL manages the Juno mission for NASA. Juno is part of NASA's New Frontiers Program, managed at NASA's Marshall Space Flight Center in Huntsville, Alabama, for the agency's Science Mission Directorate. Lockheed Martin Space Systems in Denver built the spacecraft. The California Institute of Technology in Pasadena manages JPL for NASA.

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

NASA's Next Mars Rover Progresses Toward 2020 Launch

After an extensive review process and passing a major development milestone, NASA is ready to proceed with final design and construction of its next Mars rover, currently targeted to launch in the summer of 2020 and arrive on the Red Planet in February 2021.

The Mars 2020 rover will investigate a region of Mars where the ancient environment may have been favourable for microbial life, probing the Martian rocks for evidence of past life. Throughout its investigation, it will collect samples of soil and rock and cache them on the surface for potential return to Earth by a future mission.

To reduce risk and provide cost savings, the 2020 rover will look much like its six-wheeled, one-ton predecessor, Curiosity, but with an array of new science instruments and enhancements to explore Mars as never before. For example, the rover will conduct the first investigation into the usability and availability of Martian resources, including oxygen, in preparation for human missions.

Mars 2020 will carry an entirely new subsystem to collect and prepare Martian rocks and soil samples that includes a coring drill on its arm and a rack of sample tubes. About 30 of these sample tubes will be deposited at select locations for return on a potential future sample-retrieval mission. In laboratories on Earth, specimens from Mars could be analyzed for evidence of past life on Mars and possible health hazards for future human missions.

Two science instruments mounted on the rover's robotic arm will be used to search for signs of past life and determine where to collect samples by analysing the chemical, mineral, physical and organic characteristics of Martian rocks. On the rover's mast, two science instruments will provide high-resolution imaging and three types of spectroscopy for characterising rocks and soil from a distance, also helping to determine which rock targets to explore up close.

A suite of sensors on the mast and deck will monitor weather conditions and the dust environment, and a ground-penetrating radar will assess sub-surface geologic structure.

The Mars 2020 rover will use the same sky crane landing system as Curiosity, but will have the ability to land in more challenging terrain with two enhancements, making more rugged sites eligible as safe landing candidates.

Terrain-relative navigation on the new rover will use onboard analysis of downward-looking images taken during descent, matching them to a map that indicates zones designated unsafe for landing.

NASA
http://www.nasa.gov
http://mars.nasa.gov/mars2020

Astronaut News

By Rob Wood

Opening Comments

Instead of its normal title, this issue of Astronaut News could have been called ISS Crewing News. We have NASA's press release confirming two ISS crews for 2017 to discuss, and Canadian and European assignments. There is also some discussion on 2018 crews.

And there was some other news too. We have a bumper edition of 'Where Are They Now', the Hubble Repairman retires again and the start of a new astronaut selection process.

The Next Canadian is…

Navdeep Bains was standing behind the lectern. He spoke, "We are here today, to find out who will be the next Canadian to fly to space." It was Monday, 16 May 2016. Schoolchildren sat either side of him with an adult audience to his front. They were at the Canada Aviation and Space Museum in Ottawa. Typical of this type of venue, lighting was low.

"Starting in August," Bains continued. "Our next Canadian astronaut will begin training for his mission and in November of 2018, he will launch to the International Space Station, he will conduct science and maintain the station and perhaps operate Canadian robotics on behalf of our country."

He noted that the next Canadian astronaut was an engineer, an astrophysicist and a medical doctor, and commented that this was, "Very impressive, eh?" Then the news we were waiting for. "So please join me in welcoming David Saint-Jacques."

News of the impending announcement came out of the Canadian Space Agency (CSA) on 13 May 2016, when they invited media representatives to an event three days later. They said the Honourable Navdeep Bains, Minister of Innovation, Science and Economic Development, and Minister responsible for the CSA, would make an important announcement on human spaceflight to the ISS.

The CSA also noted that present at the event would be Sylvain Laporte, the CSA President, together with an unnamed CSA astronaut. It did not need Hercule Poirot to work out that we were about to find out the name of the next Canadian astronaut to receive a flight assignment.

When Chris Hadfield retired in 2013 Canada was left with two active astronauts, Jeremy Hansen and David Saint-Jacques. They were both rookies but for one, the long wait was nearly over; at least for the start of his training for a specific spaceflight. For an International Space Station (ISS) expedition mission there was a two-year plus a bit lead-in training programme. It was still better than he could have expected a few years ago.

Back in 2013, provisional ISS crewing slots suggested that there was not even a tentative place for a Canadian astronaut before ISS Expeditions 62/63 (December 2019 to June 2020). There was some hope that a commercial crew vehicle might provide for another place; however, taking into account likely delays with the new vehicles then this could not have been realistically expected before the end of the decade either.

Saint-Jacques has been assigned to ISS-58/59. He is to launch on a Russian Soyuz rocket in November 2018. He will then spend six-months on the orbiting laboratory carrying out Canadian and international experiments. The mission will mark the 17th spaceflight for the Canadian Astronaut Corps.

To date, eight official Canadian astronauts have flown on 16 spaceflights. In addition, a Canadian private spaceflight participant, Guy Laliberté, also visited space. Hansen and Saint-Jacques were selected as CSA astronauts in 2009 and were the third Canadian selection. Six astronauts were chosen in 1983 and four in 1992.

The first Canadian in space was Marc Garneau, flying as a payload specialist on Space Shuttle mission STS-41G (1984). He later qualified as a mission specialist and made two more spaceflights, STS-77 (1996) and STS-97 (2000). The most recent was Chris Hadfield, who is the only other Canadian to make three spaceflights, STS-74 (1995), STS-100 (2001) and Soyuz TMA-07M/ISS-34/35 (2012/2013).

The first group of Canadian astronauts was made up of Roberta Bondar, Marc Garneau, Steven MacLean, Kenneth Money, Robert Thirsk and Bjarni Tryggvason. All flew in space except Money. He did serve as back-up to Bondar for her mission but left the astronaut corps later the same year. Bondar was the second Canadian in space on STS-42 (1992). MacLean flew twice, STS-52 (1992) and STS-115 (2006); Thirsk also flew twice including an ISS expedition, STS-78 (1996) and Soyuz TMA-15/ISS-20/21 (2009), and Tryggvason flew once, STS-85 (1997).

I previously noted that four astronauts were selected for Canada's second group in 1992 but that is not entirely accurate. On 8 June 1992, four astronauts were named for the second selection: Chris Hadfield, Julie Payette, Robert Stewart and Daffydd Williams. Almost immediately Stewart decided to withdraw for what the CSA said was for personal reasons. The Canadian Encyclopedia states he resigned because of uncertainty about future shuttle flights. He was replaced by Michael McKay who also left early when medical reasons caused him to withdraw in 1995.

The remaining three members of the second group had solid space careers. As previously noted Hadfield made three spaceflights. The other two made two spaceflights each: Williams flew on STS-90 (1998) and STS-118 (2007) and Payette on STS-96 (1999) and STS-127 (2009).

David Saint-Jacques walked out from the dark at the rear of where Navdeep Bains was standing. He received the applause of the gathered audience. The Minister greeted him with a handshake then continued to speak. "Before David gets on I want to say a few words about our special guest and astronaut here today. David you are a true model for young Canadians. You are part of a new generation of Canadian astronauts that will continue our nation's proud history in human spaceflight and prepare us for exploration beyond the space station. Along with all Canadians I will follow your training, launch and mission with great interest and excitement, and I know that you will do us proud. On behalf of all Canadians, I thank you for your courage and wish you all the best. Thank you very much David."

David Saint-Jacques thanked the Minister before starting his own speech. Similarly to the Minister he spoke a mixture of French and English, although both mostly used the English language.

"Here I am through all these years of work ready to join my first space mission. The doctor in me is eager to conduct experiments and experience first-hand the effects of micro-gravity on my body; the engineer in me is eager to operate Canadarm 2; the astrophysicist in me is eager to look at the stars while floating in my spacesuit; and of course the adventurer in me, well he is just eager.

I stand on the shoulders of giants. First, the astronauts who have preceded me, they were my childhood inspiration, my colleagues and my mentors. I want to thank in particular my friend, Canadian astronaut Jeremy Hanson, who has been living working training together for seven years helping each other every step along the way. Today I'm the lucky one to be picked but I know very well it could have been him. I can't wait for him to get his mission next.

Today, we are announcing the seventeenth Canadian space mission, the third long term to the International Space Station, it is incredible, and this is through the efforts of thousands of people, visionaries, deciders, scientists, engineers, managers, all the support staff; whether they

are from the Government, the Canadian Space Agency, universities, industry, I stand on their shoulders as well.

To the students here, I just want to tell how I became an astronaut. When I was a young boy, I saw a photo of the Earth, seen from space. And I remember thinking. Wow, that's a hard picture to take. So I asked my father, hey Dad, where was the photographer standing? And he told me, well David, the photographer, he was standing on the Moon. The picture was taken by somebody who had left Earth.

I realised that science could jump out of the pages of text books and send a human to the Moon. Science could be pretty cool. Science is fuelled by our imagination. I always loved travel and the adventure of discovering different cultures, I get that from my Mother, and from my Father, I understood that science /technology are the tools I can use to discover and explore the world around me and even beyond, because dreamers and scientists we need both to explore.

I look forward to living and working on board the space station and seeing the world floating in space, just like on that photo I saw when I was a child. Humbled to represent all Canadians on this mission, you pick me, you train me and now you're putting your trust in me. I promise to do my best to live up to your expectations."

David Saint-Jacques (Ph.D., M.D.) was born on 6 January 1970 in Quebec City, although he grew up in Saint-Lambert, near Montreal. His father was a professor of physics and his Mother was a history and literature teacher. In 1993, he received a Bachelor degree in Engineering Physics from École polytechnique de Montréal, Canada and in 1998 a Doctor of Philosophy (Ph.D.) degree in Astrophysics from Cambridge University, UK. In 2005, he earned a Doctor of Medicine (M.D.) from Université Laval in Quebec City.

His Ph.D. studies included theoretical work on astronomical observation and design, fabrication and commissioning of instruments for the Cambridge Optical Aperture Synthesis Telescope in Cambridgeshire and for the William Herschel Telescope in the Canary Islands. From 1999 to 2001, his postdoctoral research included the development and application of the Mitaka Infrared Interferometer in Japan and the Subaru Telescope Adaptive Optics System in Hawaii. In 2001 he joined the Astrophysics group at the Université de Montréal.

Following graduation as a medical doctor in 2005, he worked at McGill University's Faculty of Medicine in Montreal. He was also a clinical faculty lecturer whilst at McGill. From 2007, he was a medical doctor and the Co-Chief of Medicine at Inuulitsivik Health Centre in Puvirnituq, Canada, an Arctic village by Hudson Bay.

He was in Puvirnituq when he heard about the new astronaut recruitment. He was working late when a colleague briskly came into his office singing the song 'Fly Me to the Moon'. She told him, "Hey, they're recruiting astronauts, so you better apply." He was somewhat surprised because he had never expressed any thoughts about becoming an astronaut to anyone at the centre. It was as if the World had stopped for a second. He had to go for it.

It was on 31 March 2008, that Jim Prentice, who at the time was Minister of Industry for Canada with responsibility for the CSA, announced a new astronaut recruitment drive. The application process opened on 24 May 2008 and by its close on 27 June 2008, 5352 persons had applied.

From Saint-Jacques's viewpoint, he found that one of the main challenges of the selection process was its drawn out nature. It took a whole year of tests and interviews. He said it was a challenge to stay focused on the whole process. He did, and was one of two successful applicants when they were announced on 13 May 2009.

He was selected as a Canadian astronaut in 2009 (CSA Group 3). He joined NASA's 2009 astronaut candidates (NASA Astronaut Group 20) for his basic training. This was successfully completed in 2011 and he was assigned to duties in the Robotics Branch at the Johnson Space Center in Houston.

He has participated in NASA's NEEMO (NASA Extreme Environment Mission Operations) and ESA's CAVES (Cooperative Adventure for Valuing and Exercising human behaviour and performance Skills) programmes. He was an aquanaut during the NEEMO 15 undersea exploration mission to the Aquarius undersea research habitat off the coast of Florida in October 2011 and a cavenaut on CAVES 2012, caving on the Mediterranean island of Sardinia in September 2012. The aim of these missions is to provide a convincing analogue to space exploration.

He was appointed a crew support astronaut for ISS Expeditions 35/36 (part of which was Chris Hadfield's mission), which took place in 2013. He undertook CapCom duties for ISS Expedition 38 (2013/2014); the Cygnus-1 through to Cygnus-4 ISS resupply missions (2013/2014); and the SpaceX CRS-6 ISS resupply mission (2015).

At the time of his assignment to ISS-58/59 he was a Capcom instructor and supported visiting vehicle operations in the ISS Integration Branch of the NASA Astronaut Office.

New Astronaut Selections Update

Canada

A few issues ago I wrote, "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." In spaceflight, as in politics, one should perhaps consider very carefully before making forecasts.

'Astronauts Wanted: Canada is Recruiting Astronauts for Future Space Missions' headlined the news release by the CSA on 17 June 2016. They are looking for two new astronauts who will join NASA's 22nd class of astronaut candidates for training. The CSA are accepting applications for these two places from 17 June 2016 to 15 August 2016.

On the CSA website are the 'Requirements and conditions of employment for astronauts' for the current recruitment drive. What is interesting is the education requirements which in part says a bachelor's degree in engineering or science ***and/or*** a doctorate in medicine or dentistry. This reads like they are looking for two candidates with a medical background. That seems a little strange but that is how it reads. I suspect it must be an error but it is a double error with and/or plus the following note of medicine doctorate's only. It will be interesting to see if it is amended in the coming days.

The day after the application period ends will see the preselection of applicants who meet the basic requirements. Those who meet these requirements will be invited to take an online Public Service Entrance Examination. They will be able to take the examination from 16 August 2016 to 6 September 2016. Those successful at this juncture will need to pass three further stages: 1. Preliminary interview and medical tests; 2. Additional tests, further medical examinations and security clearance; 3. Final interview and medical examinations. The dates for these three hurdles are currently being kept secret.

The two successful candidates will be announced by August 2017. In August 2017, they will relocate to Houston, Texas, and the same month report to the Johnson Space Center to commence astronaut candidate training.

And The Next European is…

We only had to wait two days following the CSA announcement of Saint-Jacques for ESA news of a European astronaut assignment. German Chancellor Angela Merkel was at the European Astronaut Centre (EAC) in Cologne, Germany, on 18 May 2016 and this was perhaps (sic) a clue to the nationality of the astronaut.

Along with Merkel, ESA Director General Jan Woerner and media representation, present were a number of ESA astronauts, including currently active members of the team: Jean-Francois Clervoy, Samantha Cristoforreti, Pedro Duque and Alexander Gerst. As part of the events of the day, the announcement of German astronaut Gerst's assignment was made next to the mock-up of the Columbus space laboratory in the training area of the EAC.

Gerst had flown to the ISS in 2014 and was the second of the 2009 class of ESA astronauts to fly in space following Italy's Luca Parmitano. Under the current schedule Gerst will be the first of his class to make two spaceflights. His second mission will commence with the launch

of Soyuz MS-9 in May 2018 and will continue to November 2018. He will be a member of the crews of Expeditions 56 and 57 and will be the commander of the space station during the second part of his stay.

The first ESA astronaut to command the station was Frank De Winne who took charge of ISS-21 in 2009. He was also the first non-American/ Russian to occupy the command position. Chris Hadfield of the CSA was the second International commander of the ISS, taking charge of ISS-35 in 2013. The following year, Japan Aerospace Exploration Agency (JAXA) astronaut Koichi Wakata took command of ISS-39. With the current schedule, Gerst will be the fourth International astronaut and second from ESA to command an expedition.

"I am humbled by receiving the honour to command the International Space Station," Gerst said. "This international sign of trust reflects ESA's reliability as a cooperation partner, and was made possible by the fantastic work of my European colleagues on their previous missions. I am delighted by the prospect of continuing the scientific work that has been conducted on the ISS for many years. I am particularly looking forward to contributing to one of humanity's greatest exploration adventures: discovering new horizons.

Eleven European countries participate in the ISS through their membership of ESA: Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom. The other partners are: USA, Russia, Japan and Canada.

With ESA's British astronaut Tim Peake recently having ended his stint on the ISS, there are two more ESA flights planned before Gerst. Peake returned to Earth on 18 June 2016, in November 2016 Thomas Pesquet will commence his mission to the station and then at the end of May 2017 Paolo Nespoli will launch on his flight.

Alexander Gerst (Ph.D.) was born in Künzelsau, a small rural town in the south of Germany, on 3 May 1976. As a youngster he had a questioning mind and was always interested in exploration and knowledge. As a four year old he would ask his parents about dinosaurs, storms, the sun, the stars etc. His grandfather was an amateur radio operator and at five and six he loved to get involved.

He graduated from the Technical High School in Öhringen, Germany, in 1995. As he looked towards his further education, he found it difficult to decide what to specialize in. He knew it would be something related to science and engineering because he wanted to explore his surroundings and build the technology to do so. In the end he chose geophysics. He would later say this was possibly from a coincidence.

He explained, "I was in New Zealand, backpacking after school. I was just trying to see the world, to get acquainted with different cultures and just see what is out there, to get a good base for a decision on what I would choose for my path of life. I saw the volcanoes of New Zealand that had just been active at that time and I saw the remains of eruptions and thought that was a very interesting field of science because it is new. We don't know much about volcanoes and they can even be dangerous. They affect ten percent of the world's population that lives in the vicinity of volcanoes. So I thought that this is a subject where I can bring in my intuition, where I can bring in maybe new ideas and help out and then just bring some light into the darkness and that is what it turned out to be. In the end I worked on earthquakes and volcanoes but it could have been in any other field of science that I see as relevant that I would have loved to work."

He received a Bachelor of Science degree in Geophysics from the University of Karlsruhe, Germany, in 1999 and a Master of Science degree in Earth Sciences from the Victoria University of Wellington, New Zealand, in 2003. Both degrees were awarded with distinction.

Between 1998 and 2009, he participated in various international scientific collaborations and field experiments. He visited remote volcanic locations in Antarctica and on other continents, where he installed various scientific instruments and carried out research for his degrees and doctorate.

From 2001 to 2003, whilst conducting research for his master's thesis on a volcano in New Zealand, he developed a new volcano monitoring technique that might one day improve the ability to forecast volcanic eruptions. He worked on the development of scientific instruments as a scientist at the Institute of Geophysics at the University of Hamburg between 2004 and 2009. In 2007, he received the Bernd Rendel award for outstanding research from the German Research Foundation.

In 2010 he received a Ph.D. degree in Natural Sciences from the Institute of Geophysics of the University of Hamburg, Germany. His dissertation was on geophysics and volcanic eruption dynamics. He is the author and co-author on several papers published in scientific journals.

On 10 April 2008, ESA announced they were recruiting more astronauts. Gerst was one of almost 10,000 people who originally registered as candidates through the ESA website prior to the closing date for applications on 18 June 2008. Of these 8,413 fulfilled the initial application criteria. Based upon the initial announcements they were competing for just four vacancies although ultimately six would be chosen.

On 20 May 2009, he was named as one of the six successful candidates. "I was a happy scientist by the time I got selected into the ESA astronaut corps," he noted later. "I was just about to organize a stay in Alaska to investigate the volcanoes there and was looking forward to that, of course. And now, to put it in the words of my colleague Samantha Cristoforetti, I swapped out the second best job in the world for the best one."

He officially joined ESA in September 2009. Basic training included: general survival-skills work in Italy, scuba diving in the EAC neutral buoyancy pool and lessons in Russian, orbital mechanics and piloting. He successfully completed initial training in November 2010. On 18 September 2011, ESA announced his assignment to ISS Expeditions 40/41. His training took him around the World, including Canada, Japan, Russia and the USA. The training was intensive and sometimes saw him working 60-hour weeks. As part of his duties, he served as a back-up flight engineer for ISS Expeditions 38/39 that launched on Soyuz TMA-11M on 7 November 2013.

At 01:57 hrs local time (19:57 GMT), on 29 May 2014, Soyuz TMA-13M launched from the Baikonur Cosmodrome in Kazakhstan. Just under six hours later the Soyuz docked with the ISS at the Mini-Research Module 1, otherwise known as 'Rassvet' (Dawn). Gerst was flight engineer-2 for the Soyuz and an ISS flight engineer for ISS Expeditions 40/41.

The ESA mission was called 'Blue Dot' after astronomer Carl Sagan's description of Earth as "a pale blue dot". He had been looking at a photograph of the Earth taken by NASA's Voyager spacecraft when it was six billion kilometres from our planet. Earth was seen as a faintly visible object.

Gerst carried out an extensive programme of research and engineering, including physical science, biology, human physiology, radiation research and technology demonstrations. He also had maintenance duties and helped keep the orbital outpost running smoothly.

He was the prime operator overseeing the docking of Europe's last Automated Transfer Vehicle (ATV), named after the Belgium astronomer 'Georges Lemaître'. Otherwise known as ATV-5, Gerst also had responsibility for the unloading of its cargo. It had docked with the ISS on 12 August 2014 following its launch from the Guiana Space Centre in Kourou, French Guiana, on 29 July 2014 local time.

On 7 October 2014, he made a 6 hour, 13 minute, EVA. Working with NASA's Reid Wiseman, a failed ammonia cooling pump was moved from the mobile transporter where it had been temporarily housed during a previous spacewalk to an insulated bay on External Stowage Platform 2 located on the port side of the Quest Airlock. Gerst then replaced one of two lights in a video camera on the starboard side of the Destiny module. The light is used during robotic operations and when resupply spacecraft close in on the station. He then rejoined his partner to help with the installation of the Mobile Transporter Relay Assembly, which was to provide backup power options to the Mobile Transporter (MT) railway-like system. The Canadarm2 robotic arm uses the MT to move along the length of the space station's main truss.

He returned to Earth on 10 November 2014 in the descent module of

Soyuz TMA-13M. Touchdown was on the steppes of Kazakhstan at 03:58 GMT. His mission had lasted 166 days. He was the first ESA astronaut to fly directly to the EAC after landing rather than via Moscow. Although directly is not quite correct.

The Soyuz crew were picked up from the landing site by Mil MI-8 helicopters and flown to a nearby airfield. Russian teammate Maksim Surayev was then flown to Moscow but Gerst and his American colleague, Wiseman, boarded a NASA Grumman Gulfstream III aircraft. Wiseman was heading for Houston but at the aircraft's first refuelling stop in Glasgow, Gerst changed aircraft to travel to Cologne-Bonn Airport.

Post-flight examinations and research activities were conducted at the EAC. Early access allowed ESA doctors to monitor him closely and allow the researchers to get to work quickly on their guinea pig.

NASA Announce ISS Crewing for 2017

On 6 May 2016, NASA's press release proclaimed that "NASA, Space Station Partners Announce Future Mission Crew Members". Actually, none of the crewing details it contained was new to those of us who watch Russian sources or read my 'ISS Crewing Updates' column in CapCom.

The NASA news release contained crew details for missions to the ISS in the second half of 2017. It noted that the selection included NASA astronauts Scott Tingle and Randy Bresnik. Chief Astronaut Christopher Cassidy said of their assignments, "There's so much going on aboard the space station at this point, so many science experiments and technology demonstrations. Scott and Randy have their work cut out for them, but I have no doubt they'll do excellent jobs."

Tingle will fly with Roscosmos cosmonauts Aleksandr Skvortsov and Ivan Vagner. They will launch in September 2017. The three will form the ISS Expedition 53 crew with NASA astronaut Jack Fischer, ESA astronaut Paolo Nespoli and Roscosmos cosmonaut Fyodor Yurchikhin who will already be on the space station.

Bresnik will fly with Roscosmos cosmonaut Sergey Ryazansky and Norishige Kanai of JAXA. Launching in November 2017, they will join Tingle, Skvortsov and Vagner on station for ISS Expedition 54 and continue as part of Expedition 55 with another crew that will be launched in March 2018.

The press release did not give the spacecraft to be used but because of the make-up of each crew and the number three, we can surmise it will be Russian Soyuz spacecraft. No medal for me there, as a quick look at many other websites will confirm this. Why is NASA so shy at naming the spacecraft? Are they embarrassed that they still have to use Russian vehicles to get them into space and think no one will notice if they do not mention it. They should 'wake up and smell the coffee'.

Skvortsov, Vagner and Tingle are scheduled to use the Soyuz MS-6 spacecraft and Ryazansky, Kanai and Bresnik will use Soyuz MS-7.

The crews mentioned above have all been previously discussed in the pages of CapCom – for example see the March/April 2016 issue. The earliest point I saw Bresnik and Tingle linked to these flights was 8 September 2015 when they were named on the Novosti Kosmonavtika message board as being provisionally appointed to the crews. In fact, even NASA had made known the Tingle and Bresnik assignments earlier than the news release with the astronauts official NASA biographies updated to show the assignments in November 2015 (Bresnik) and December 2015 (Tingle).

Aleksandr 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: Soyuz TMA-18/ISS Expeditions 23/24 (2010) and Soyuz TMA-12M/ISS Expeditions 39/40 (2014). He has degrees in Aeronautics and Law.

Ivan Vagner was selected as a cosmonaut in 2010. He was born on 10 July 1985 and has a Master's degree in Engineering and Technology. From 2008, he worked for the S P Korolyov Rocket and Space Corporation Energiya at their Mission Control Centre, in the city of Korolyov, near Moscow. He is a spaceflight rookie.

Scott 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.

Sergey 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 cosmonaut team at the Yuri Gagarin Cosmonaut Training Centre. He has flown one ISS residency: Soyuz TMA-10M/ISS Expeditions 37/38 (2013/2014).

Norishige 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.

Randy 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 was born on 11 September 1967. He joined NASA as an astronaut candidate in 2004 (Group 19). He flew as a mission specialist on STS-129 Atlantis (2009), an ISS assembly mission. He holds degrees in Mathematics and Aviation Systems.

ISS Crewing Updates – Sort of Official

Further to the previous item, the March/April 2016 issue also showed Russian participation in the first two missions of 2018: Sergey Prokopyev and Oleg Artemyev to launch (expected March 2018) on Soyuz MS-8 for ISS Expeditions 55/56 and Aleksandr Samokutyayev for Soyuz MS-9/ISS Expeditions 56/57 (expected launch in May 2018).

There has been no press release from them, but NASA's official astronaut biographies show that in March 2016 Andrew Feustel's was updated to show he was assigned to the March 2018 launch. Although not noted in her NASA biography as of the end of June 2016, it is shown on several websites that Jeanette Epps will be on the May 2018 mission with Samokutyayev and Gerst.

The source for Epps assignment appears to be local news out of Syracuse, New York, where she was born. She was speaking to the public and school children during a two day visit in April 2016 and openly discussed her assignment to an ISS crew. She said she will be on a Soyuz spacecraft when it launches from Kazahkstan in May 2018.

Andrew Feustel is already a veteran of two spaceflights. He was born on 25 August 1965. He has a Ph.D. in the Geological Sciences and worked for Exxon Mobil Exploration Company as an exploration geophysicist before joining NASA. He joined NASA as an astronaut candidate in 2000 (Group 18). He was a mission specialist on two Space Shuttle flights to the ISS: STS-125 Atlantis (2009) and STS-134 Endeavour (2011).

Jeanette Epps was a NASA fellow during her time at graduate school. However, following receipt of her Ph.D. in Aerospace Engineering in 2000 she joined the Ford Motor Company in their Science Research Laboratory. In 2002, she became a technical intelligence officer with the Central Intelligence Agency. She was born on 3 November 1970. She joined NASA as an astronaut candidate in 2009 (Group 20). She has served as a crew support astronaut for ISS expeditions and in 2014 was a crew member for NEEMO 18, an underwater space analogue mission. She has yet to fly in space.

Sergey Prokopyev is a cosmonaut from the 2010 selection. He is a spaceflight rookie although he was apparently considered as a replacement for Sarah Brightman on Soyuz TMA-18M when she withdrew from the mission in May 2015. In the event, Kazakh cosmonaut Aydyn Aimbetov flew the mission in September 2015 with Prokopyev serving as his back-up. Prokopyev was born on 19 February 1975. He holds degrees in Aeronautics and Economics. He has served as a pilot in the Russian Air Force, flying Tupolev Tu-22M3 and Tu-160 strategic bombers.

Oleg 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: Soyuz TMA-12M/ISS Expeditions 39/40 (2014).

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

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

In August 2012, whilst still active as a cosmonaut, Roman Romanenko was appointed a deputy commander of the cosmonaut corps at the Yuri Gagarin Cosmonaut Training Centre. In 2014, he was stood down from active status when he failed the cosmonaut medical tests but he continued in his management role. On 12 October 2015, he was relieved of this post in order to take up a position in the State Duma of the Federal Assembly of the Russian Federation (part of Russia's Parliament – lower house of the Federal Assembly). He was selected as a cosmonaut in 1997 and flew two ISS residencies: Soyuz TMA-15/ISS Expeditions 20/21 in 2009 and Soyuz TMA-07M/ISS Expeditions 34/35 in 2012/2013, accumulating 333 days in space.

From April 2011 to December 2015, Thomas Reiter was Director of ESA's Directorate of Human Spaceflight and Operations at the European Space Operations Centre in Darmstadt, Germany. From January 2016, he has been Director of Manned and Robotics Exploration at the European Space Research and Technology Centre in Noordwijk, the Netherlands. Reiter was an ESA astronaut from 1992 to 2007. He flew residency missions to the Mir and ISS space stations accumulating 350 days in space: Soyuz TM-22/Mir-20 (1995/1996) and STS-121/ISS-13/14/STS-116 (2006).

Talgat Musabayev was the Chairman of Kazcosmos, Kazakhstan's space agency, from 2007 to 2016. On 20 January 2016, by the Order of the Head of state, he was appointed Adviser to the President of the Republic of Kazakhstan. He was selected as a cosmonaut in 1990 and was both a Kazakh and Russian cosmonaut. After serving as a Kazakh back-up in 1991, he made three spaceflights as part of the Russian cosmonaut team: Soyuz TM-19/Mir-16 (1994), Soyuz TM-27/Mir-25 (1998) and Soyuz TM-32/Soyuz TM-31(2001 – ISS Taxi flight swapping Soyuz spacecraft), accumulating 341 days in space. He stood down as an active cosmonaut in 2003.

On 23 February 2016, World View Enterprises Inc. released the news that Ron Garan had joined them, and, I quote from their press release, "as chief pilot for current robotic flight operations and upcoming human spaceflights via balloon." It would be churlish of me to point out that the balloon is only going about 32 kilometres up and that is only short of space by about 68 kilometres. To be fair, there is very little atmosphere at that height. Garan was a NASA astronaut from 2000 to 2013 and made two spaceflights including one ISS residency: STS-124 (2008) and Soyuz TMA-21/ISS-27/28 (2011).

Recently departed from NASA Scott Kelly (see last issue for full story) has joined his twin brother Mark as a Breitling watch ambassador. It seems that as well as his officially issued Omega watch he also took two from Breitling with him on his nearly year-long spaceflight. One of the Breitling watches was a gift from Mark.

Michael Lopez-Alegria has a new website - **http://mlaspace.com/** He left NASA in March 2012 and served as President of the Commercial Spaceflight Federation until October 2014 when he became an independent consultant based in Washington DC. Currently, he consults for traditional and commercial spaceflight companies, and serves on several advisory boards and committees for public and private organizations. He is also engaged in public speaking domestically and internationally. He was a navy test pilot when he was selected as an astronaut. He was a NASA astronaut from 1992 to 2012. He made four spaceflights including one ISS Expedition: STS-73 (1995), STS-92 (2000), STS-113 (2002) and Soyuz TMA-9/ISS-14 (2006/2007). He is still NASA's most experienced spacewalker accumulating nearly 68 hours of EVA time during 10 spacewalks.

Kevin Ford who departed NASA in January 2016 announced via twitter on 20 May 2016 that he had accepted a position as researcher/educator with the Institute of Structural Engineering at the Norwegian University of Science and Technology in Trondheim. He joined NASA as a pilot astronaut in 2000 and was the pilot for STS-128 (2009) before entering ISS expedition training. He flew on Soyuz TMA-06M/ISS-33/34 (2012/2013).

The Hubble Repairman Departs NASA Again

There were five Space Shuttle servicing missions to the Hubble Space Telescope. Six astronauts flew more than one mission but only one was on three. Astronomer John Grunsfeld served as a NASA astronaut from 1992 to 2009, making five spaceflights including the three Hubble missions.

Dr Grunsfeld had originally left NASA in December 2009 to become the Deputy Director of the Space Telescope Science Institute (STScI) at the Johns Hopkins University in Baltimore, Maryland, effective from 4 January 2010. STScI manages the science programme for Hubble and is a partner in the forthcoming James Webb Space Telescope currently targeted at an October 2018 launch on an European Ariane 5 rocket.

After two years with STScI, Dr Grunsfeld returned to NASA on 4 January 2012. He was appointed as its Associate Administrator for the Science Mission Directorate at the agency's headquarters in Washington D. C. He worked for NASA for a little over four more years before he again decided to leave. His effective last day was 30 April 2016.

"After exploring strange new worlds and seeking out new life in the universe, I can now boldly go where I've rarely gone before – home," said Grunsfeld. "I'm grateful to have had this extraordinary opportunity to lead NASA science, and know that the agency is well-positioned to make the next giant leaps in exploration and discovery."

Under his stewardship preparations are well underway for a host of other missions and activities that will continue his work. These include the first US mission to return a sample of an asteroid, the first mission to look for signs of life on Jupiter's moon Europa, a mission to study the sun closer than ever before, participating in a national space weather strategy and constructing the next rover to Mars.

During his time as Associate Administrator for the Science Mission Directorate he has managed more than 100 science missions. These include the Curiosity rover Mars landing in August 2012, the Deep Space Climate Observatory launched in February 2015 and the July 2015 New Horizons Pluto flyby.

"John leaves an extraordinary legacy of success that will forever remain a part of our nation's historic science and exploration achievements," said NASA Administrator and former astronaut Charles Bolden. "Widely known as the 'Hubble Repairman,' it was an honour to serve with him in the astronaut corps and watch him lead NASA's science portfolio during a time of remarkable discovery. These are discoveries that have rewritten science textbooks and inspired the next generation of space explorers."

John Mace Grunsfeld (Ph.D.) was born on 10 October 1958 in Chicago, Illinois. He might have been hauling heavy loads on America's highways but for the arrival of television. As a youngster he had wanted to drive heavy trucks but then his family purchased a television set.

It was the early days of the space age and there was wall to wall coverage of human spaceflight on television. His first memories of spaceflight were of NASA's second manned spacecraft programme, Gemini. Dr Grunsfeld explained during a NASA interview, "And so, at that time I kind of changed my mind from wanting to be a heavy truck driver to being an astronaut. So, I've really wanted to be an astronaut my whole life and go out and explore space."

As he grew up, he played space games with his friends. Space equipment came from everyday objects. He used a vacuum cleaner with a hose as his liquid cooling unit for the walk out to the pretend launch site. He used big ice cream tins as space helmets. He would make a hole on one side of the tin and then put cellophane over it as a makeshift visor area.

His grandmother gave him a small telescope which he used to look at the Moon and this helped pique his interest in space and exploration. His interests in science, exploring and finding out how things worked led him to choose physics to study at college, "it seemed to me that through physics you can figure out how everything works, even the universe." He attended the Massachusetts Institute of Technology for undergraduate studies. Like NASA, almost no one uses the University's full title, its acronym, MIT, is primarily used as its identifier. Such is the prestigious standing of this education establishment.

During his first year at MIT he took a part-time job as a satellite operator for the Small Astronomy Satellite 3, a NASA X-ray astronomy space telescope. "I would change the tapes and monitor strip chart recorders and make sure the spacecraft was operating, all for a couple bucks an hour," He said. "I just loved it, and it introduced me to the scientists who were working on the programmes at MIT and also scientists from other institutions who would come to visit."

Whilst at MIT one of his areas of study was Hubble, Not yet the space telescope but Hubble's Law in connection with the expansion of the universe. He was at MIT for four years and left with a Bachelor of Science degree in Physics in 1980. He then spent a year as a visiting scientist at the University of Tokyo working on Japanese satellites and X-ray astronomy before in 1981 returning to the states to enter the University of Chicago.

Whilst at Chicago he received a Master of Science degree (1984) and a Ph.D. degree (1988), both in Physics. He stayed at the University of Chicago as a W.D. Grainger Postdoctoral Fellow in experimental physics for a further year and then moved on to the California Institute of Technology; another establishment better known by a shorter version of its title, namely Caltech, where he was a senior research fellow. He worked there from 1989 to 1992 when he was selected as an astronaut.

He applied to join NASA's 1990 class of astronauts (Group 13) and was a semi-finalist. He was called for interview and examination at the Johnson Space Center in Houston in October 1989 but he had to wait a little longer for success in his ambitions to be an astronaut. When that class was announced on 17 January 1990 he was not amongst its number. NASA announced its next astronaut recruitment on 2 May 1991. He again applied and was called back to Houston in December for another round of interview and examination.

At Caltech he, "couldn't imagine a better career," he later said. He was working with the Compton Gamma Ray Observatory, he used the Palomar Observatory and its big telescopes; he was studying neutron stars and black holes, and he thought, "this is fantastic, you know -- this is the golden era of astronomy and I'm a part of it. I thought life couldn't be better."

It could, a phone call came in from Houston and he was asked would he like to join them as an astronaut? "Well, I had to think about it for a millisecond or so," he said. He was selected as a mission specialist astronaut in 1992 (NASA Group 14).

He made five spaceflights over the next 15 years including his three Hubble repair missions. His first spaceflight was STS-67 Endeavour (2-18 March 1995), this was the second flight of the Astro observatory, a unique complement of three ultra-violet telescopes. His next mission was his one and only visit to a space station, STS-81 Atlantis (12-22 January 1997) was the fifth shuttle mission to dock with Russia's Mir space station and he was the flight engineer for the shuttle spacecraft.

The rest of his astronaut career in space involved the Hubble Space Telescope. He visited the telescope three times making spacewalks on all the missions, accumulating over 58 hours of EVA in 8 spacewalks. STS-103 Discovery (19-27 December 1999), STS-109 Columbia (1-12 March 2002) and STS-125 Atlantis (11-24 May 2009). He was the payload commander and lead spacewalker on his second repair flight, and then reprised the role of lead spacewalker for the third. He was the last human to touch the space telescope during the final EVA of the STS-125 mission.

In between spaceflights, he also gained experience in a variety of ground assignments. After STS-81, he served as Chief of the Computer Support Branch in the Astronaut Office supporting shuttle and ISS programmes, and advanced technology development. Following STS-103, he was assigned as Chief of the Extravehicular Activity Branch in the Astronaut Office. Following his fourth spaceflight, STS-109, he was an instructor in the Extravehicular Activity Branch and Robotics Branch, and worked on the exploration concepts and technologies for use beyond low earth orbit in the Advanced Programmes Branch. He was NASA's Chief Scientist detailed to NASA Headquarters in 2003-2004 where he helped develop the then President's (George W. Bush) Vision for Space Exploration.

Towards the end of 2004, it was decided he would fly an ISS residency mission. Early the following year he was assigned to the back-up crew for ISS-13 and the prime crew for ISS-15 but before the end of 2005, he was no longer involved in these missions. It is not clear why this happened but it has been speculated that this was with an eye on what would become STS-125. In January 2004, the fifth Hubble repair mission had been cancelled amidst much controversy but by the end of 2005 it looked likely to be re-instated and this was confirmed in October 2006 with Grunsfeld assigned as a member of the crew. This would turn out to be his final spaceflight.

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.

Mark Kelly and Scott Kelly: 7-8 October 2016 with Space Lectures events in Pontefract.

Mike Massimino: 25 October 2016 at a talk and book signing in Blackburn – organised by Silverwood Events.

Kenneth Cameron, Gregory Chamitoff and Charles Walker: 12-14 May 2017 at the Autographica Autograph Show in London. The date has changed and Shannon Lucid is no longer listed.

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/ Fortune Magazine has named Scott Kelly and Mikhail Korniyenko as 22nd on their list of the 'World's Greatest Leaders' for 2016.

2/ Port Columbus International Airport is to be renamed the John Glenn Columbus International Airport after the first American to orbit the Earth. On 25 May 2016, lawmakers in Ohio unanimously voted in favour of the change.

3/ On 7 June 2016, Orbital ATK announced that their Cygnus CRS OA-5 spacecraft which will fly a resupply mission to the ISS (possible launch in August 2016) will be named for Alan Poindexter in a continuation of its policy of naming their resupply spacecraft after deceased astronauts. Poindexter died in a tragic water sports accident in 2012. He was pilot then commander for two Space Shuttle ISS missions.

Continued on page 15...

ISS Mission Update

By George Spiteri

Expedition Forty-Seven is drawing to a close. The International Space Station (ISS) is Commanded by US astronaut Tim Kopra, who is manning the orbital complex with Flight Engineers, American Jeff Williams, Russians Yuri Malenchenko, Alexei Ovchinin and Oleg Skripochka and Great Britain's Tim Peake.

Kopra celebrated his 53rd birthday on 9th April and Tweeted his thanks to all his friends "for making this an epic day".

SpaceX's Dragon unmanned commercial resupply vehicle was grappled by Canadarm2 at 1223 BST on 10th April and berthed onto the Harmony Module's Earth facing port over two and a half hours later at 1457 BST. This marked the first time there were two US commercial vehicles at the ISS and only the second time in ISS history six visiting vehicles were docked at the orbiting outpost, the previous time being in 2011 during the STS-133/"Discovery" mission.

The crew celebrated the 55th anniversary of Yuri Gagarin's pioneering flight in 1961 on 12th April. Russia's President Vladimir Putin took the opportunity to speak to the crew, telling them that "in spite of all the challenges that we face on the ground" people in space were "working shoulder to shoulder" for the benefit of all humanity.

The Bigelow Expandable Activity Module (BEAM) was extracted by Canadarm2 from Dragon's unpressurised trunk at approximately 0720 BST on 16th April and attached onto the aft port of the Tranquility Module over three hours later at 1036 BST. BEAM marked the first human rated expandable structure flown in space. The 3,115 pound Module will stay at the Station for two years with crewmembers periodically entering it three to four times a year to take data samples from radiation and temperature sensors inside BEAM.

Peake Tweeted the ultimate birthday greetings to Her Majesty Queen Elizabeth II on the occasion of her 90th birthday on 21st April and posed together with the message inside the Station's Cupola.

The crew commemorated Earth Day on 22nd April and according to Dr Lisa Vanderbloemen, the Manager of the Earth Science and Remote Sensing Unit at JSC taking photographs from orbit "we can get dynamic shots from the ISS....that's a big part of what we do" and the crew really "enjoy taking pictures" which Kopra, Williams and Peake post almost on a daily basis on their Twitter accounts.

On 23rd April, Tim Peake celebrated St. George's Day in space by Tweeting a photo of his EMU suit with the English flag as a backdrop and the message "Have a great St George's Day England!"

The following day, Peake ran the London Marathon from orbit using the Station's treadmill. He ran in support of the Prince's Trust charity and completed the 26.2 mile run in 3 hours 35 minutes 21 seconds using the Station's COLBERT T2 treadmill inside Tranquility, which according to NASA was the "Fastest marathon in space" by 49 minutes.

At 1245 BST on 27th April, DIWATA-1, the first Filipino satellite was released from a satellite deployer mechanism outside the Kibo Module's airlock. The 50kg-class microsatellite is designed to study the Earth and climate change.

The cosmonauts celebrated the Russian Orthodox Easter on 1st May and spoke to Patriarch Kirill of Moscow and all Russia, who congratulated them "on this joyous day of Easter".

Kopra and Williams celebrated US Mother's Day on 8th May with Kopra Tweeting a photo of his birthplace Austin, Texas, where his mother still resides.

The following day was Victory Day, commemorating the defeat of Nazi Germany in 1945. Malenchenko, Ovchinin and Skripochka recorded a message to the people of Russia saying that their work in space "is possible only in a world without war".

At 1419 BST on 11th May, Dragon was released by Canadarm2 and after completing a de-orbit burn nearly five hours later at 1901 BST splashed down in the eastern Pacific Ocean, 261 miles South-West of Long Beach, California about one hour after that at 1951 BST (1151 local time) with over 3700 pounds of returned cargo onboard.

At 0710 BST on 16th May the ISS began its 100,000th orbit as it crossed the Equator. NASA calculated that the Station had travelled 2,643,342,240 miles around the Earth, roughly equivalent to the distance between Earth and Neptune or ten Earth-Mars round trips!

At 1105 BST and 1540 BST on 16th May, two sets of CubeSats were deployed by Peake from Kibo's airlock, including the first satellite built by an elementary school. This was followed by several more CubeSats totalling seventeen in all which were also deployed on 17th and 18th May.

The first attempt to expand BEAM was halted after two hours at approximately 1400 BST on 26th May, when the Module only expanded axially by five of the 68 inches at least expected. A second attempt began two days later at 1404 BST when Williams opened the valve inside Tranquility for the first of twenty-five short bursts of air into BEAM for a total of 2 minutes 27 seconds. In what NASA TV described as "a slow and incremental process" pressurization of BEAM began over seven hours later at 2134 BST and the 13 foot long and 10.5 foot diameter Module was fully deployed, expanded and pressurized ten minutes later, becoming the first human-rated expanded habitat in space. Wearing protective goggles, masks and headlamps Williams along with Skripochka opened the hatch to BEAM at 0947 BST on 6th June and entered the Module for the first time to collect air samples and began downloading data from sensors on the dynamics of BEAM's expansion. Williams told Mission Control Houston that BEAM looked "pristine" and said it was cold inside but there was no evidence of condensation on its inner surfaces. Williams entered BEAM two more times on 7th and 8th June before finally closing the hatches, the next crew entry is due in August.

Kopra and Williams observed US Memorial Day on 30th May with Kopra Tweeting his respects to the "brave men and women who made the ultimate sacrifice for our country".

Four more CubeSats were deployed from Kibo's airlock, with the first pair launched at 1240 BST on 30th May and the second pair at 0145 BST on 31st May respectively. Four more pairs of CubeSats were later launched between 0500 BST on 31st May and 0410 BST the following day and two further CubeSats were then deployed at 0315 BST on 2nd June.

As of 10th June, Kopra, Malenchenko and Peake have logged 179 days in orbit, whilst Williams, Ovchinin and Skripochka have been in space for nearly three months.

They Also Served:

In Memory of those we lost in 2015
The Ground Crew – Part Two

By Rob Wood

Oscar Carl Holderer (4 November 1919 – 5 May 2015) was part of Wernher von Braun's team at Peenemünde during World War Two, working on Nazi Germany's ballistic missile programme. He would later re-join von Braun in the United States to help with America's military ballistic missiles. He worked with von Braun on the Saturn series of launch vehicles that would take astronauts to the moon. He died a few days after suffering a stroke.

"He was one of the more hands-on members of the team," his son Michael said. "He had his own machine shop here in town as a hobby." Ed Buckbee, a former NASA public affairs officer and space author noted that, "He brought our first rocket wind tunnel in this country from Germany and personally set it up." He also designed the high-speed wind tunnel that was used to develop the Saturn V rocket and oversaw its construction.

"He was a very talented man, not only an aeroballistics expert but very accomplished in design and fabrication," was a further comment by Ed Buckbee. Holderer retired from NASA in 1974, but continued to work on public awareness of spaceflight. He designed and built many exhibits and interactive displays at the US Space & Rocket Center Museum in Alabama. In his own workshop he converted the tail section of a jetliner into a small theater for the space museum. "They would tilt it back to simulate acceleration," his son said.

He was born in Prüm, Germany, but became a US citizen in 1955. He arrived in the US in 1945 in the second group of German scientists and technicians brought to America after World War Two. This was as part of Operation Paperclip.

The Office of Strategic Services (OSS) was a United States spy agency established during World War Two and the forerunner of the Central Intelligence Agency. Operation Paperclip (initially known as Operation Overcast) was run by the OSS to enable German engineers and other useful persons to be brought to the US. With the 'Cold War' looming this was in part to keep the German expertise from the Soviets but it should not be doubted that this was also to keep their eminence over their allies.

Von Braun's team was originally based in White Sands, New Mexico before moving in 1950 to the Redstone Arsenal in Alabama. When NASA came into being in 1958, their Marshall Space Flight Center was based there. At Marshall, Holderer worked as a mechanical engineer, designer, fabricator and photographer. He held 19 patents as a result of his work and innovations.

John William 'Jack' King (12 February 1931 – 11 June 2015) was the 'Voice of Apollo'. As the Chief of NASA's Public Information Office, he provided public commentary from Kennedy Space Center's Launch Control Center of the countdown and lift-off for every American manned spaceflight from Gemini 4 in 1965 through to Apollo 15 in 1971 with the exception of Apollo 13 in 1970. However, it was his countdown for Apollo 11 that he will always be remembered for.

From his seat in the Firing Room at Kennedy he counted down, "20 seconds and counting, T-15 seconds, guidance is internal, 12, 11, 10, 9, ignition sequence starts, 6, 5, 4, 3, 2, 1, 0, all engine running. LIFTOFF! We have a lift-off, 32 minutes past the hour. Lift-off on Apollo 11… Tower cleared."

He was born in Brighton, Boston, Massachusetts. Whilst attending Dorchester High School, he spent his vacations as an office boy for the Associated Press (AP). In 1951, he was formerly recruited by AP whilst attending Boston College. In 1953, he graduated with an English degree. After graduation he was commissioned as a second lieutenant in the United States Army artillery corps. He served for two years including postings to South Korea and Japan. Following military service he returned to AP as a news reporter in their Boston Bureau.

Explorer 1 was the first successful satellite launch by the US. It was put into orbit on 31 January 1958. Shortly after this, King was assigned by AP to Cape Canaveral as their first permanent space journalist. He opened the AP's Cape Canaveral Bureau and was their Bureau Chief through 1958 and 1959.

He joined NASA in 1960 as Chief of Public Information for the Kennedy Space Center. There were a lot of classified military launches but they could not be kept totally secret. People living in the area knew when a launch took place and there were always media questions. This caused King difficulties during his early days with NASA. "The biggest PR job I had to do was with our own people in order to get information that I could pass out to the news media," King said during an interview for an oral history project in June 2002.

In 1972, he was promoted to Director of Public Affairs for NASA's Johnson Space Center in Houston. There he had wider responsibilities for directing programmes that included education outreach, exhibits and astronaut appearances, as well as intergovernmental and community relations.

He was part of the team that negotiated news coverage with the Soviets for the 1975 Apollo-Soyuz Test Project, the first link-up of two manned spacecraft between nations. The agreement included the provisions for the first live television coverage of a Russian rocket launch and Soyuz landing. The mission provided a moment of détente in the Cold War.

He left NASA in 1975 but continued in media affairs, initially remaining in Government service for another two years before entering the private sector. From 1997, he worked for the United Space Alliance where he was responsible for their news/media relations. United Space Alliance was NASA's prime contractor for day-to-day Space Shuttle operations. He retired from United Space Alliance in October 2010, but continued to serve as a NASA public affairs volunteer. He died as a result of congestive heart failure.

Claudia Joan Alexander (30 May 1959 – 11 July 2015) was the last Project Manager for NASA's Galileo probe to Jupiter and until her death was Project Manager and Project Scientist for NASA's part of ESA's Rosetta mission to explore Comet 67P/Churyumov–Gerasimenko.

She was born in Canada, but raised in Santa Clara, California, right in the centre of Silicon Valley. She earned a Bachelor's degree in Geophysics from the University of California, Berkeley, and a Master's degree in Geophysics and Space Physics from the University of California, Los Angeles. A Doctorate followed in Atmospheric, Oceanic and Space Sciences from the University of Michigan, Ann Arbor. She became the Project Manager for NASA's Galileo mission in 2000 at the relatively young age of 40.

Her research studies have included the evolution and interior physics of comets, Jupiter and its moons, magnetospheres, plate tectonics, space plasma, the solar wind and the planet Venus. One of her passions was

inspiring young people. In her spare time, she wrote children's books on science and mentored young African-American girls. She also wrote "steampunk" science fiction short stories.

She died on 11 July 2015, after a ten year battle with breast cancer. Matt Taylor, a British astrophysicist, Project Scientist for Rosetta and a very public face for ESA during the Rosetta mission spoke of her passing, "We have lost a great colleague and friend who will live on within us and the missions to the stars she made possible."

A few years ago she talked about her favourite moment in her career, "We were watching the first data come down from the Galileo mission's first encounter with Jupiter's moon Ganymede, and the data clearly showed the presence of some sort of ionosphere (a very thin atmosphere, which we now call a 'surface bound exosphere') in the region. When I saw this evidence, I burst out saying '"I don't believe it!"' (I had, up until that time, done a lot of modelling work to prove that the moon was frozen solid.) The presence of a little bit of atmosphere meant that we needed to re-think our past assumptions concerning Ganymede as an undisturbed, pristine and inactive moon. It was an exciting moment to experience something that changed my whole way of thinking. I've never been so happy to be wrong before!"

In September 2015, her colleagues from the Rosetta mission named a place on the target comet 67P/Churyumov-Gerasimenko in her honour. A gate-like feature was named the C. Alexander Gate.

Avul Pakir Jainulabdeen Abdul Kalam (15 October 1931 – 27 July 2015) was Project Director of India's first indigenous launch vehicle which was given the uninspiring if literal name of Satellite Launch Vehicle (SLV). A former colleague said, "The success of our space programme, our missile development and our nuclear weaponry all owe their genesis to him."

His interest in aeronautics was inspired by an article he read as a schoolboy about the World War Two British Spitfire fighter aircraft. This would lead him to the Madras Institute of Technology where he earned a degree in Aeronautical Engineering. He wanted to be a fighter-pilot and applied to the Indian Air Force. He was ranked nine of 25 candidates but unfortunately only eight places were available.

At the same time he had applied to join the Indian Air Force as a fighter-pilot he had also put in an employment application to the Defence Research and Development Organisation (DRDO) of the Ministry of Defence. They offered him a job as a senior scientific assistant with the Aeronautical Development Establishment. He would spend nine years with them until 1969 when he transferred to India's newly formed space agency, the Indian Space Research Organisation (ISRO).

In 1963, he was part of a group of India's engineers who visited a number of NASA's space centres to study and learn about sounding rockets, their scientific payloads, tracking the rockets and receiving data. On return to India, they helped develop and run the Thumba Equatorial Rocket Launching Station from where India ran its sounding rocket programme.

Initially, foreign rockets were used. Later, India developed its own sounding rockets. One of Kalam's early tasks was working on the rocket's payloads. He then pioneered fibre glass technology and led a design team developing composites rocket motor cases; technology that would be incorporated into the design of the SLV.

In the late 1960's, studies had been made on an indigenous launch vehicle and the go-ahead to develop it was given in 1970. Kalam, was originally appointed as Project Director for the fourth stage of the rocket; at this point each stage had its own director. In 1972, the position was consolidated under one lead and he became Project Director for the whole vehicle.

The first launch of the SLV on 10 August 1979 failed when a faulty solenoid valve in the second stage led to the loss of its red fuming nitric acid. Eleven months later they were ready for a second attempt. On 18 July 1980, from the Sriharikota High Altitude Range rocket launch centre, SLV successfully placed a Rohini satellite (RS-1) into orbit. India became the seventh nation to launch its own satellite on its own launcher. In order, those that came before were: USSR, USA, France, Japan, China and UK.

In June 1982, after a short period at the headquarters of ISRO in Bangalore, Kalam returned to DRDO to head their laboratory in Hyderabad, the main centre for missile development. From 1992 to 1999, he was the scientific adviser to the defense minister and from 1999 to 2001, principal scientific adviser to the government with the rank of cabinet minister.

He played a significant role in the development and testing of India's nuclear delivery missiles and the nuclear bombs themselves. He was involved in the Prithvi and Agni ballistic missile programmes. Prithvi is a battlefield tactical nuclear missile and Agni a longer range nuclear delivery system. He served as one of two Project Chief Coordinators for the Pokhran-II nuclear bomb tests, which took place in 1998.

His involvement in the nuclear programme brought him much acclaim in India and the tabloid newspaper nickname of 'Missile Man'. Or, his involvement, as the Telegraph newspaper so succinctly and explicitly put it within their obituary when describing his work on nuclear weapons, "proved beyond doubt that India was capable of obliterating its old enemy Pakistan, should it feel the need."

The Telegraph said he had no regrets on his involvement in nuclear tests and quote him as saying, "In our planet only weaponised states are friends. Strength respects strength." The tests caused consternation internationally; sanctions were threatened and in some cases enacted. But most were lifted within five years. Overall, their effects were limited. In a strange combination of bedfellows, France, Russia and the UK declined to condemn India.

From 2002 to 2007, he served as President of India, albeit a largely ceremonial Head of State role. Following his term of office, he worked in the fields of education and research; lecturing in many academic and research establishments. He wanted to engage and inspire youth to help with the development of India as a nation. It has been estimated, that during the last ten years of his life he spoke to over five million young persons below the age of 17.

On 27 July 2015, he was delivering a lecture at the Indian Institute of Management in Shillong when he collapsed. He had suffered a heart attack. He was rushed to hospital but declared dead shortly after arrival. He was laid to rest on 30 July with full state honours.

In his 2013 autobiographical work, 'My Journey: Transforming Dreams into Actions' he summed up his own life, "Love poured to the child... struggle... more struggle... bitter tears... then sweet tears... and finally a life as beautiful and fulfilling as seeing the birth of the full moon."

George Edwin Mueller (16 July 1918 – 12 October 2015) was Associate Administrator for NASA's Office of Manned Space Flight from 1963 through 1969. To do justice to his story would take up a whole issue of CapCom. What follows, I hope, gives a flavour of his part in the history of spaceflight.

He totally reorganised both the general and technical management of the Apollo Programme and many argued that these changes led to the successful moon landing before the end of the decade as promised by President Kennedy. Some people found him difficult to work for and did not always agree with him but even they acknowledge the success of his all-up testing procedures.

Although he was a NASA manager, he did have a technical background. He was born in St. Louis, Missouri. As a youngster he enjoyed reading science fiction but he was also good at making things. He built model ships/airplanes and his own radio receiving sets. Following high school he attended the Missouri School of Mines and graduated with a Bachelor of Science degree in Electrical Engineering in 1939. The following year he received a Master of Science degree in the same field from Purdue University in Indiana.

He worked at Bell Labs in New Jersey from 1940 to 1946 and during World War Two became involved in airborne radar technology with the company. Following the war he left Bell and became an assistant professor of electrical engineering at Ohio State University where he earned a Ph.D. in Physics in 1951. He became an associate professor of electrical engineering at Ohio State University.

In between teaching he worked as a consultant for the 'Ramo-Wooldridge Corporation'. In 1957, he joined the company full time. From 1958, the company became part of TRW Inc. Mueller joined their Space Technology Laboratories (STL) division. He was involved in the design, development, and testing of the basic systems and components of the Atlas, Titan, Minuteman, and Thor ballistic missiles. At STL he made his first contact with NASA whilst working on the design and construction of a series of lunar probes called Pioneer. He also helped with the establishment of the United States Air Force tracking network for deep space probes.

D. Brainerd Holmes was NASA's Director of the Office of Manned Space Flight from September 1961 until August 1963. NASA Administrator James Webb sounded out TRW for a replacement and they suggested Mueller. A biography for him on one of NASA's website pages states that Mueller was originally appointed as Deputy Associate Administrator for Manned Space Flight in September 1963 but from November 1963 the Deputy part of the title was dropped. Mueller himself does not totally agree. For the NASA Oral History Project interview in 1998 he says, "Actually, I started that associate administrator business." During the interview he suggests that he was never a deputy.

Whatever the title of his appointment, it did not take him long to decide NASA needed to introduce all-up testing procedures if they were to have any chance of meeting President Kennedy's promise to put an American on the Moon "before this decade is out." Mueller thought that with the original plan for testing the launch vehicle and Apollo spacecraft, NASA would not have got astronauts on the Moon before 1971 at the earliest.

In 1998, he was asked about how he came to that decision, "Oh, it was easy," he said. "You just looked at the schedule, and you could see that if you went through the test program that Marshall had laid out for the launch vehicle, that you weren't going to be landing on the moon in the decade." He added that he believed many others involved in the programme thought the same. However, there was some opposition to his ideas.

Wernher von Braun was probably the most vocal against the new plan but he eventually agreed. In NASA's own history 'Apollo Expeditions to the Moon' von Braun says, "George Mueller's reasoning was impeccable," and adds. "In retrospect it is clear that without all-up testing the first manned lunar landing could not have taken place as early as 1969."

He first had to make sure three of NASA's centers were under his direct responsibility; The Manned Spaceflight Center (later Johnson Space Center), Marshall Space Flight Center and Kennedy Space Center. They were all significant players in the lunar landing project but "they barely talked to each other," he later said. He was able to use his position to persuade the leadership of the centres to come round to his way of thinking.

The original plan for the Saturn launch vehicle called for a lot of test flights. With testing of one stage of the rocket at a time, with dummy other stages, slowly building up to the full stack. Mueller's idea was that the first test flight would be of the whole launch vehicle. Von Braun explained, "To the conservative breed of old rocketeers who had learned the hard way that it never seemed to pay to introduce more than one major change between flight tests, George's ideas had an unrealistic ring. Instead of beginning with a ballasted first-stage flight as in the Saturn I programme, adding a live second stage only after the first stage had proven its flightworthiness, his 'all-up' concept was startling. It meant nothing less than that the very first flight would be conducted with all three live stages of the giant Saturn V. Moreover, in order to maximize the payoff of that first flight, George said it should carry a live Apollo command and service module as payload."

When Mueller was asked why he had the freedom to make the necessary changes to the Apollo Programme he said it was, "because President Kennedy said, '"We're going to land on the Moon by the end of this decade,"' and no one wanted to be accused of interfering with that."

When the Saturn 5 was first launched on 9 November 1967 all rocket stages and the Apollo spacecraft were fully functional. This was a first for NASA for a new launch and spacecraft system. Less than two years later Neil Armstrong took that small step for mankind.

As well as overseeing the completion of the Apollo Programme, he was also responsible for the beginning of the development of the Skylab space station. He was instrumental in the decision to use a Saturn V stage for Skylab. Originally, the go had been given for a Saturn-IVB spent stage to be converted into a habitable station by astronauts when already in space. During a visit to Marshall, Mueller took to the water, scuba diving in the neutral buoyancy tank at the spaceflight centre, where a mock-up of a spent stage of a Saturn-IVB had been set up for training purposes. He saw for himself how difficult the tasks would be.

Years later Mueller told the story of his Marshall diving experience. "I decided I wanted to see for myself what was going on. So I did that one Saturday, and decided then that it wasn't likely we were going to be able to refurbish this thing in space. It's just too hard to work in a neutral buoyancy environment. If you're in a spacesuit, it's even worse. You had to do the initial refurbishment, or furbishment, I guess, without air. So you had to be in a spacesuit and you had to do all of the preliminary work in a spacesuit. I figured by the time we did that, why, we would have exhausted several astronauts and our programme in the process."

During his time with NASA he also advocated a fully reusable space transportation system. Although this was expensive to develop, he believed it would considerably reduce costs in the long run, freeing up money for other projects. In fact, he helped put together ideas for a grander plan for space exploration but he decided to leave NASA before decisions were made. A partially reusable space transportation system that became known as the Space Shuttle was developed. None of the other ideas were given the go ahead. One of the reasons for the shuttle being partially reusable was the initial development costs.

Of the decision to be partially reusable only, he is pretty scathing, "Well, it has caused a continuing review of whether we ought to be in space at all," he commented. "And it is something that has really hobbled the space programme over the last two decades, because so much of the funds that could have been used elsewhere are being absorbed in flying the Shuttle."

He resigned from NASA on 10 November 1969, effective from 10 December 1969. He would later say there were several reasons for his decision. "One is that the decision had been made to terminate the Apollo programme and that was a good time to leave, and let someone else take over for the next phase." He then gave a financial reason. "From a practical point of view, I needed to go make some money so I could keep my family going. It was costly for us to join the Apollo programme. My salary was half what I was making in industry when I went there, and it was just a strain to keep the family going and work going at the same time. So I went back to industry."

He held a number of positions with several companies in the years that followed. These included: General Dynamics Corporation, System Development Corporation, Burroughs Corporation, Jojoba Propagation Laboratories and from 1995, Kistler Aerospace. He was the Chief Executive Officer of Kistler and found himself on familiar territory. He was back to where he had left NASA in 1969 as Kistler were trying to develop a fully reusable launch system. He retired from Kistler Aerospace in 2004. They never completed the project to produce a fully reusable launch system.

His main legacy is without doubt the 'all-up' concept for testing the Saturn launch vehicle. There were certainly strong and powerful critics of the way he reorganised the general management structure of NASA's manned spaceflight organisations and also of his style of management but even they were in agreement that 'all-up' got America to the Moon in 1969.

Chris Kraft, NASA's first manned mission flight director in Mission Control; later Director of the Johnson Space Center and certainly one of the major players within NASA said in 'Flight', his autobiography, "The growing mountain of Mueller's bureaucracy looked to us working troops as unnecessary, cumbersome and expensive. It turned out to be all three." He added, "We did the job in spite of Mueller's management schemes." He said that Mueller was, "at times tough to work for," and added, "I chafe from certain memories."

But even he, despite strong negative views, acknowledged the success of 'all-up'. Kraft wrote, "The concept of 'all-up' testing was his. He saved us hundreds of millions of dollars and cut months, if not years, from the time it took us to land on the Moon."

In the final analysis, even his most fierce critics accepted his role as a major contributor to the success of the Apollo 11 Moon landing. He died at his home in Irvine, California, as a result of congestive heart failure.

Closing Notes

There were many others who played a role in space exploration and died in 2015, sadly to many to write about in detail. Some brief notes follow on a few:

Physicist Ernest Joachim Sternglass (24 September 1923 – 12 February 2015), his own research plus correspondence and discussions with Albert Einstein led to an electron amplification discovery. When Neil Armstrong made humanity's first tentative steps on the Moon in 1969 live on television, inside the camera that filmed him was a highly sensitive television camera tube, the origins of which were in Sternglass's early research.

Jimmy Justice, or more correctly James William Henry Justice (2 June 1925 – 13 May 2015), was born in London but moved to America in the 1950's when recruited by the Westinghouse Electric Corporation. He later said that Westinghouse "made me an offer I couldn't refuse." Westinghouse had already produced black and white television live from the Moon and he was asked to produce a colour television system. He came up with a proposal in double quick time and NASA gave his company a contract to produce the system in six months, which they did.

Dale Dehaven Myers (8 January 1922 – 19 May 2015), took over from George Mueller as NASA Associate Administrator for Manned Space Flight. He served in this role from 1970-1974. Previous to this he was Vice-President and Programme Manager, Apollo Command/Service Module Programme, North American-Rockwell, from 1964-1969. Having left NASA in 1974, he returned in October 1986 as Deputy Administrator in the aftermath of the Challenger accident and is credited with assisting greatly to get the space programme back on track and moving forward with optimism. He did not want the job initially but a telephone call from President Reagan persuaded him otherwise, ''I couldn't think of any more excuses,'' Myers said at the time. ''He's a very persuasive man.''

Robert Terry Neal (14 July 1942 – 19 May 2015), had various roles on all NASA manned space programmes from Apollo to the ISS. In 1972, using the mock-up facility at Johnson, he helped develop a fix for the Apollo 17 Lunar Rover right rear fender, which had been half torn off accidently by moonwalker Eugene Cernan during the first EVA of the mission. He continued to play a significant role in EVA operations over several decades including working in this field for the Space Shuttle and ISS programmes. He was lead EVA operations flight controller for the first Space Shuttle spacewalk, the first Manned Manoeuvring Unit flight and the first Space Shuttle satellite repair mission.

James Turner Rose (21 September 1935 – 24 May 2015), was an early advocate for commercialising of space. He was one of the original Space Task Group members when it was established by NASA in November 1958 to manage their manned spaceflight projects. He swapped regularly from working for NASA to working for McDonnell-Douglas; often working on the same projects for both organisations, such as Gemini and Space Shuttle but at different times. He was the driving force and Project Director for 'Electrophoresis Operations in Space' (EOS). EOS exploited the unique aspects of space microgravity to separate pharmaceuticals in space under a joint commercial agreement between industry (McDonnell Douglas/Ortho Pharmaceuticals) and NASA.

Walter Joseph 'Kappy' Kapryan (16 May 1920 – 14 August 2015), was Director of Launch Operations at the Kennedy Space Center from Apollo 12 in 1969 through to the pre-flight days of the Space Shuttle in 1979. He was with NASA from its beginning in 1958 until he retired in 1979. He was instrumental in an on-time launch of Apollo for the Apollo-Soyuz Test Project (ASTP). "During the terminal countdown for the ASTP mission, a crucial 'Go-No Go' decision had to be made in real time on a hydraulic oil leak problem in a critical swing arm system," said Ike Rigell, acting Director of Shuttle Cargo Operations. "Kappy very quickly analyzed our work-around capabilities and made the right decision to continue the count and launch on time."

Norman Rodney Parry (22 December 1933 – 19 November 2015), was an engineer who joined Werner Von Braun's Army Ballistic Missile Agency in February 1956. In 1960, he transferred to NASA along with many of his colleagues. He worked on many of the launch vehicles used to put satellites and manned spacecraft into space, including for the USA's first satellite, Explorer 1, in 1958. He retired from NASA in 1989 but remained an active volunteer with their Public Affairs Office. More than ten years after technically retiring he commented, "There is no ex-NASA, it's something that stays with you forever. If you cut me, RP1 Rocket Fuel would bleed out."

Acknowledgements and sources:

Abdulkalam.com; Air and Space magazine; Al.com; Ancestry.com; Associated Press; Britannica.com; Collect Space; Collective Legacy Project; Cornell Chronicle; Deke! US Manned Space From Mercury to the Shuttle ©1994 by Donald 'Deke' Slayton with Michael Cassutt; Dignitymemorial.com; ESA; Familysearch.org; Flight My Life in Mission Control ©2001 by Chris Kraft; Gateway to the Moon ©2001 by Charles D. Benson and William B. Faherty; The Guardian; The Hindu; Indian Space Research Organisation; The Man Who Ran the Moon ©2006 by Piers Bizony; NASA and its various centres; The New York Times; Orlando Sentinel; Reach for the Stars ©2000 by Gopal Raj; Space.com; The Space Shuttle Decision 1965-1972 ©2002 by T A Heppenheimer; The Telegraph; Times of San Diego; USA Today; The Washington Post; Wikipedia; Jill Wood; You Tube.

... from page 10

Comments & Upcoming In The Next Issue Of Astronaut News

Congratulations to Tim Peake on the successful conclusion of his mission to the ISS. Whilst he was awaiting his aircraft ride from Karaganda International Airport he was interviewed by the British media. He looked a little tired understandably but he was able to give his first thoughts about his return to Earth. "Obviously it's going to take a few days before I feel normal again. Feeling a lot of dizziness and vertigo at the moment anytime I move my head, which is to be expected. That's normal after six months in space. In those first few moments on the steppes of Kazakhstan, you know, the smells and the breeze really hit me very hard and it was great to be back on Earth, it really was." For more details on Peake's mission see George Spiteri's ISS Mission Updates.

As for the next issue, we have a report on ESA, JAXA, NASA, Russian and Chinese astronauts working side-by-side. Wow! Also, there will be some news on Russian cosmonaut retirements and I am sure there will be more news about astronauts.

Acknowledgements and sources:

Americaspace.com; Astroaddies; Astronaut.ru; Autographica; BBC.co.uk; The Canadian Encyclopedia; Canadian Space Agency; CapCom (previous issues); Collect Space; ESA; Fortune Magazine; The Globe and Mail; Google; Karaganda International Airport; Kazcosmos; Linkedin; Manned Spaceflight Log II 2006-2012 ©2013 by David J Shayler and Michael D Shayler; Mlaspace.com; NASA and its various centres; NASA Astronaut Selections ©2003 AIS Publications; NASASpaceflight.com; Novosti Kosmonavtika; Physicsoftheuniverse.com; Praxis Manned Spaceflight Log 1961-2006 ©2007 by Tim Furniss and David J Shayler with Michael D Shayler; RussianSpaceWeb.com; Spacefacts; Space Lectures; Syracuse.com; Who's Who in Space ©1999 by Michael Cassutt; Wikipedia; World View Enterprises Inc.; You Tube; Yuri Gagarin Cosmonaut Training Centre.

Rob Wood

Esa Commits To Next Stage Of Uk Revolutionary Rocket Engine

The UK's Farnborough airshow saw ESA's commitment to the next step in developing a revolutionary air-breathing rocket engine that could begin test firings in about four years.

The Synergistic Air-Breathing Rocket Engine, SABRE, is a unique engine designed to use atmospheric air in the early part of its flight to orbit before switching to rocket mode for its final ascent to space.

The UK's Reaction Engines Ltd has been working on SABRE for many years. Success could lead to single-stage-to-orbit spaceplanes.

ESA is investing €10 million in SABRE, joining £50 million from the UK Space Agency. Since 2008, ESA has played an important technical management role.

In 2010, ESA independently reviewed SABRE's viability, opening the way to UK government investment.

Back in 2012, ESA oversaw the testing of a key element – the precooler that chills the hot airstream entering the engine at hypersonic speed. To render the air usable by the engine as oxidiser it needs to be cooled from 1000°C to –150°C in just a hundredth of a second – at the same time as avoiding the formation of potentially dangerous ice.

A number of research and development projects followed through ESA, helping to demonstrate the feasibility of other elements, such as the novel rocket nozzles, air intake design and thrust chamber cooling. ESA also helped to refine the overall SABRE design, looking at how it could be manufactured.

this years Farnborough Air Show saw the contract signing by Franco Ongaro, ESA's Director of Technical and Quality Management, and Mark Thomas, Chief Executive Officer of Reaction Engines Ltd, to commit the next stage of ESA funding towards SABRE.

"Reaction Engines and ESA have been working together since 2008 to make the SABRE concept a reality," says Director Ongaro.

"This new contract marks an important milestone in our continued collaboration to mature the design. It should take us to a point where we can expect to be testing a demonstrator engine in 2020."

In about two years, this latest phase should define the configuration of the engine as well as allow the detailed design of the prototype demonstrator engine to begin.

Once the feasibility of the technology was demonstrated via individual elements in 2012, the next step is to build a ground demonstrator engine in 2020, which will bring all these elements together to verify the performance of the complete engine cycle.

The end result of this made-in-Europe technology would be low-cost, reliable and reusable engines, potentially enabling future vehicles that could perform the equivalent job of today's rockets while operating like an aircraft – revolutionising access to space.

ESA
http://www.esa.int
http://www.reactionengines.co.uk/

Advance Notice

Wednesday 5 October

BIS West Midlands Space Night Event

This year the BIS West Midlands Space Day Event will be held on Wednesday 5 October at a new home at the Hive in Worcester

More details to follow in the next edition of CapCom

Space and astronomy organisations are encouraged to get in touch to have a stand or for members to give a talk

Anyone interested should contact:

west-midlands@bis-space.com

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 **September/October 2016** issue should be emailed to the editor by **Friday 12 August 2016**