your window to space





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space news roundup

NASA's Cassini Spacecraft Ends Its Historic Exploration of Saturn

A thrilling epoch in the exploration of our solar system came to a close on 15 September 2017, as NASA's Cassini spacecraft made a fateful plunge into the atmosphere of Saturn, ending its 13-year tour of the ringed planet.

"This is the final chapter of an amazing mission, but it's also a new beginning," said Thomas Zurbuchen, associate administrator for NASA's Science Mission Directorate at NASA Headquarters in Washington. "Cassini's discovery of ocean worlds at Titan and Enceladus changed everything, shaking our views to the core about surprising places to search for potential life beyond Earth."

"The Cassini operations team did an absolutely stellar job guiding the spacecraft to its noble end," said Earl Maize, Cassini project manager at JPL. "From designing the trajectory seven years ago, to navigating through the 22 nail-biting plunges between Saturn and its rings, this is a crack shot group of scientists and engineers that scripted a fitting end to a great mission. What a way to go. Truly a blaze of glory."

As planned, data from eight of Cassini's science instruments was beamed back to Earth. Mission scientists will examine the spacecraft's final observations in the coming weeks for new insights about Saturn, including hints about the planet's formation and evolution, and processes occurring in its atmosphere.

"Things never will be quite the same for those of us on the Cassini team now that the spacecraft is no longer flying," said Linda Spilker, Cassini project scientist at JPL. "But, we take comfort knowing that every time we look up at Saturn in the night sky, part of Cassini will be there, too."

Go behind the scenes in a 360-degree view inside mission control to see as we await the FINAL signal and science data until the very last moment from our Cassini spacecraft. After nearly 20 years in space, NASA's Cassini mission to Saturn is at the end of its remarkable journey of exploration.

Cassini launched in 1997 from Cape Canaveral Air Force Station in Florida and arrived at Saturn in 2004. NASA extended its mission twice - first for two years, and then for seven more. The second mission extension provided dozens of flybys of the planet's icy moons, using the spacecraft's remaining rocket propellant along the way. Cassini finished its tour of the Saturn system with its Grand Finale, capped by Friday's intentional plunge into the planet to ensure Saturn's moons - particularly Enceladus, with its subsurface ocean and signs of hydrothermal activity - remain pristine for future exploration.

While the Cassini spacecraft is gone, its enormous collection of data about Saturn - the giant planet, its magnetosphere, rings and moons - will continue to yield new discoveries for decades to come.

Engineers at NASA's Jet Propulsion Laboratory in Pasadena, California, awaited the final transmission from the Cassini spacecraft as it plunged into Saturn's atmosphere ending its 20-year voyage of discovery.

"Cassini may be gone, but its scientific bounty will keep us occupied for many years," Spilker said. "We've only scratched the surface of what we can learn from the mountain of data it has sent back over its lifetime."

End of Cassini. Whats Next?

In revealing that Enceladus has essentially all the ingredients needed for life, the mission energised a pivot to the exploration of "ocean worlds" that has been sweeping planetary science over the past couple of decades.

Jupiter's moon Europa has been a prime target for future exploration since NASA's Galileo mission, in the late 1990s, found strong evidence for a salty global ocean of liquid water beneath its icy crust. But the revelation that a much smaller moon like Enceladus could also have not only liquid water, but chemical energy that could potentially power biology, was staggering.

Many lessons learned during Cassini's mission are being applied in planning NASA's Europa Clipper mission, planned for launch in the 2020s. Europa Clipper will make dozens of flybys of Jupiter's ocean moon to investigate its possible habitability, using an orbital tour design derived from the way Cassini has explored Saturn. The mission will orbit the giant planet (Jupiter in this case) using gravitational assists from large moons to maneuver the spacecraft into repeated close encounters, much as Cassini has used the gravity of Titan to continually shape the spacecraft's course.

In addition, many engineers and scientists from Cassini are serving on Europa Clipper and helping to shape its science investigations. For example, several members of the Cassini Ion and Neutral Mass Spectrometer team are developing an extremely sensitive, nextgeneration version of their instrument for flight on Europa Clipper. What Cassini has learned about flying through the plume of material spraying from Enceladus will be invaluable to Europa Clipper, should plume activity be confirmed on Europa.

In the decades following Cassini, scientists hope to return to the Saturn system to follow up on the mission's many discoveries. Mission concepts under consideration include spacecraft to drift on the methane seas of Titan and fly through the Enceladus plume to collect and analyze samples for signs of biology.

Atmospheric probes to all four of the outer planets have long been a priority for the science community, and the most recent Planetary Science Decadal Survey continues to support interest in sending such a mission to Saturn. By directly sampling Saturn's upper atmosphere during its last orbits and final plunge, Cassini is laying the groundwork for an eventual Saturn atmosphere probe.

Farther out in the solar system, scientists have long had their eyes set on exploring Uranus and Neptune. So far, each of these worlds has been visited by only one brief spacecraft flyby (Voyager 2, in 1986 and 1989, respectively). Collectively, Uranus and Neptune are referred to as ice giant planets. In spite of that name, relatively little solid ice is thought to be in them today, but it is believed there is a massive liquid ocean beneath their clouds, which accounts for about two-thirds of their total mass. This makes them fundamentally different from the gas giant planets, Jupiter and Saturn (which are approximately 85 percent gas by mass), and terrestrial planets like Earth or Mars, which are basically 100 percent rock. It's not clear how or where ice giant planets form, why their magnetic fields are strangely oriented, and what drives geologic activity on some of their moons. These mysteries make them scientifically important, and this importance is enhanced by the discovery that many planets around other stars appear to be similar to our own ice giants.

A variety of potential mission concepts are discussed in a recently completed study, delivered to NASA in preparation for the next Decadal Survey—including orbiters, flybys and probes that would dive into Uranus' atmosphere to study its composition. Future missions to the ice giants might explore those worlds using an approach similar to Cassini's mission.

NASA/JPL https://saturn.jpl.nasa.gov/grandfinale NASA/JPL https://saturn.jpl.nasa.gov/mission/grand-finale/whats-next

NASA's Curiosity Mars Rover Climbing Toward Ridge Top

NASA's Mars rover Curiosity has begun the steep ascent of an iron-oxide-bearing ridge that's grabbed scientists' attention since before the car-sized rover's 2012 landing.

"We're on the climb now, driving up a route where we can access the layers we've studied from below," said Abigail Fraeman, a Curiosity science-team member at NASA's Jet Propulsion Laboratory in Pasadena, California.

"Vera Rubin Ridge" stands prominently on the northwestern flank of Mount Sharp, resisting erosion better than the less-steep portions of the mountain below and above it. The ridge, also called "Hematite Ridge," was informally named earlier this year in honor of pioneering astrophysicist Vera Rubin.

"As we skirted around the base of the ridge this summer, we had the opportunity to observe the large vertical exposure of rock layers that make up the bottom part of the ridge," said Fraeman, who organized the rover's ridge campaign. "But even though steep cliffs are great for exposing the stratifications, they're not so good for driving up."

The ascent to the top of the ridge from a transition in rock-layer appearance at the bottom of it will gain about 213 feet (65 meters) of elevation -- about 20 stories. The climb requires a series of drives totaling a little more than a third of a mile (570 meters). Before starting this ascent in early September, Curiosity had gained a total of about 980 feet (about 300 meters) in elevation in drives totaling 10.76 miles (17.32 kilometers) from its landing site to the base of the ridge.

Curiosity's telephoto observations of the ridge from just beneath it show finer layering, with extensive bright veins of varying widths cutting through the layers.

"Now we'll have a chance to examine the layers up close as the rover climbs," Fraeman said.

Curiosity Project Scientist Ashwin Vasavada of JPL said, "Using data from orbiters and our own approach imaging, the team has chosen places to pause for more extensive studies on the way up, such as where the rock layers show changes in appearance or composition. But the campaign plan will evolve as we examine the rocks in detail. As always, it's a mix of planning and discovery."

In orbital spectrometer observations, the iron-oxide mineral hematite shows up more strongly at the ridge top than elsewhere on lower Mount Sharp, including locations where Curiosity has already found hematite. Researchers seek to gain better understanding about why the ridge resists erosion, what concentrated its hematite, whether those factors are related, and what the rocks of the ridge can reveal about ancient Martian environmental conditions.

"The team is excited to be exploring Vera Rubin Ridge, as this hematite ridge has been a go-to target for Curiosity ever since Gale Crater was selected as the landing site," said Michael Meyer, lead scientist of NASA's Mars Exploration Program at the agency's Washington headquarters.

During the first year after its landing near the base of Mount Sharp, the Curiosity mission accomplished a major goal by determining that billions of years ago, a Martian lake offered conditions that would have been favorable for microbial life. Curiosity has since traversed through a diversity of environments where both water and wind have left their imprint. Vera Rubin Ridge and layers above it that contain clay and sulfate minerals provide tempting opportunities to learn even more about the history and habitability of ancient Mars.

> NASA/JPL https://mars.jpl.nasa.gov/msl

NASA seeks information to develop Deep Space Gateway module

NASA is taking the next small step in the development of a proposed Deep Space Gateway in cislunar space by requesting information about one of its core modules.

A request for information (RFI), released by NASA seeks information from industry regarding their capabilities to build a Power and Propulsion Element (PPE), a module that will produce electrical power and provide chemical and electrical propulsion for the gateway.

As currently envisioned by NASA, the PPE would be the first element of the gateway, launched as a "co-manifested payload" on the first crewed Space Launch System launch, taking advantage of the additional payload capacity provided by the Block 1B version of the SLS. The PPE would go into what is known as a near rectilinear halo orbit around the moon within 100 days of launch.

The RFI describes the basic capabilities and requirements of the PPE as envisioned by NASA. The module would have a 15-year lifetime and be equipped with a solar electric propulsion system that uses xenon propellant, as well as chemical thrusters that use hydrazine. The module would weigh no more than 7,500 kilograms in order to be a co-manifested SLS payload, including a tank carrying 2,000 kilograms of xenon.

The PPE will produce electrical power, being able to transfer up to 24 kilowatts to other modules later added to the gateway. It will also support communications in several bands, as well as an optical communications demonstration payload.

In the RFI, NASA asks potential respondents their ability to produce the PPE, including a "conceptual schedule, rough order of magnitude engineering cost estimate, and recommended contract vehicle" for it. NASA expects to have the PPE delivered to the Kennedy Space Center for integration onto the SLS in December 2021, which would support a launch of the Exploration Mission 2 flight now expected for some time in 2022.

NASA hopes that the module can build on early design work for the Asteroid Redirect Mission, whose robotic spacecraft would have also used solar electric propulsion to travel to and from a near Earth asteroid. "Identify a conceptual design you would use as a starting point and what changes you believe are warranted to address PPE capability statements," NASA instructs industry in the RFI.

NASA also asks industry to address several other issues in the RFI. These range from the potential use of green propulsion alternatives for the hydrazine thrusters on the spacecraft and the use of a commercial spacecraft bus for the module to discussion of potential cost-sharing approaches for its development.

"Through the RFI, we hope to better understand industry's current state-of-the-art and potential future capabilities for deep space power and propulsion," said Michele Gates, director of the PPE effort at NASA Headquarters, in an agency statement. Gates formerly was director of the Asteroid Redirect Mission program.

The RFI and planned NextSTEP studies are NASA's next tentative steps in the development of the Deep Space Gateway concept. NASA describes the gateway as "a lunar-orbiting, crew-tended spaceport" that would also include a habitation module and docking ports for the Orion crew spacecraft and separate cargo spacecraft. The gateway's additional modules would also be delivered to cislunar space as comanifested payloads on future SLS launches.

Crews would visit the gateway on Orion missions, spending up to several weeks there before returning. The PPE would allow the gateway to change orbits, including moving closer to the moon to support any potential later missions on the lunar surface. NASA also foresees using the gateway to support the Deep Space Transport, a future spacecraft that would carry crews into deep space in preparation for Mars missions NASA seeks to fly in the 2030s.

First Look at the Crew Access **Arm For Launch Complex 39A**

[Right] Astronauts Bob Behnken and Eric Boe walk down the Crew Access Arm being built by SpaceX for Launch Complex 39A at NASA's Kennedy Space Center in Florida. The access arm will be installed on the launch pad, providing a bridge between the crew access tower and SpaceX's Crew Dragon - or Dragon 2 - spacecraft for astronauts flying to the International Space Station on the company's Falcon 9 rocket as part of NASA's Commercial Crew Program.

The access arm is being readied for installation in early 2018. It will be installed 70 feet higher than the former space shuttle access arm on the launch pad's Fixed Service Structure. SpaceX continues to modify the historic launch site from its former space shuttle days, removing more than 500,000 pounds of steel from the pad structure, including the Rotating Service Structure that was once used for accessing the payload bay of the shuttle. SpaceX also is using the modernized site to launch commercial payloads, as well as cargo resupply missions to and from the International Space Station for NASA. The first SpaceX launch from the historic Apollo and space shuttle site was February 2017.

NASA's Commercial Crew Program is working with private companies,



Boeing and SpaceX, with a goal of once again flying people to and from the International Space Station, launching from the United States. Boeing is building the CST-100 Starliner to launch on an United Launch Alliance Atlas V rocket from Space Launch Complex 41. For information on Boeing and ULA's work on Space Launch Complex 41, visit: https://www.nasa.gov/feature/crew-access-arm-installed-forstarliner-missions.

NASA https://www.nasa.gov/exploration/commercial/crew/index.html

NASA's Newest Tracking and Data Northrop Grumman to Acquire **Relay Satellite Arrives in Orbit**

The constellation of satellites charged with maintaining critical communications between NASA's Space Network and Earth-orbiting spacecraft is about to be expanded by one on 18 August 17.

Joining the Tracking and Data Relay Satellite (TDRS) System is TDRS-M, the third and final in a series of third-generation TDRS spacecraft that have taken their places in orbit in recent years.

The countdown proceeded smoothly throughout the early morning hours and into propellant-loading operations, when engineers noted an issue with the Centaur upper stage's liquid oxygen (LOX) chilldown system. The team methodically worked to resolve the issue while maximizing that window of opportunity, and the issue was resolved in time for launch officials to set up for a successful liftoff at 8:29 a.m.

> NASA http://www.nasa.gov

Mock Mars Crew Emerges from Dome in Hawaii After 8 Months of Isolation

After spending eight months simulating life on Mars on the slopes of the Mauna Loa volcano, six "astronauts" emerged from their Hawaiian habitat on Sunday 17 September to return to civilization.

This concluded the fifth mock Mars mission of the NASA-funded HI-SEAS program (Hawaii Space Exploration Analog and Simulation). Operated by the University of Hawaii, this research project studies how groups of interplanetary travelers would work together on longterm missions while in cramped quarters.

The Mission V crew entered the HI-SEAS dome on 19 January 17. During their eight-month stay on Mauna Loa, the world's largest active volcano, they conducted scientific experiments, performed daily exercises and maintained equipment in and around the dome. Outside the dome, the astronauts did geological fieldwork in their spacesuits just as if they were on Mars.

Orbital ATK

Northrop Grumman will acquire Orbital ATK in a \$9.2 billion deal the companies announced on 18 September.

Under the terms of the deal, Northrop Grumman will pay \$7.8 billion in cash and assume \$1.4 billion in debt to acquire Orbital ATK. Northrop Grumman is paying \$134.50 per share of Orbital ATK stock, a premium of more than 20 percent over the stock's price of \$110 per share at the close of trading on 15 September. News of the deal was first reported on 17 September by the Wall Street Journal.

The companies, in a statement announcing the deal, described Northrop's acquisition of Orbital as a complementary one. Orbital ATK will operate as a fourth division of Northrop Grumman, alongside aerospace systems, mission systems and technology services.

> Full Story at space.com http://www.space.com

500 New European Companies **From Space**

Thousands of new jobs and boosted local economies are the direct results from ESA's investment in young companies through its business incubators, which have now fostered more than 500 start-ups that adapt space technology and satellite services for use on Earth.

From healthcare to manufacturing, sport to agriculture, the effort is an important driver for entrepreneurship and the creation of new businesses, as well as positioning Europe at the forefront of innovation.

A personal 'flying car' in the form of an electric jet taking off and landing vertically from our own backyards is being developed by entrepreneurs at the Bavarian incubator, completing its maiden test flight last April.

A Portuguese start-up has developed a last-mile delivery service by drone, highlighting its versatility by delivering a hot meal to an elderly isolated inhabitant as well as flying parcels over Lisbon's rush-hour traffic.

Full story at space.com http://www.space.com

2017 Total Eclipse Shadow Viewed From ISS



Image above: As millions of people across the United States experienced a total eclipse as the umbra, or moon's shadow passed over them, only six people witnessed the umbra from space. Viewing the eclipse from orbit were NASA's Randy Bresnik, Jack Fischer and Peggy Whitson, ESA (European Space Agency's) Paolo Nespoli, and Roscosmos' Commander Fyodor Yurchikhin and Sergey Ryazanskiy. The space station crossed the path of the eclipse three times as it orbited above the continental United States at an altitude of 250 miles.

NASA http://www.nasa.gov

NASA http://www.nasa.gov

The 2017 Total Solar Eclipse

An Eyewitness Account

By Michael Bryce

My wife Pauline and I were amongst those millions of people across the United States who witnessed the event first hand. We were in the State of Idaho about 20 miles north of Idaho Falls at a local beauty spot called Menan Buttes. Menan Buttes, a natural beauty spot, are two of the world's largest volcanic tuff cones. Tuff cones are formed by magma-water eruptions (phreatomagmatic eruptions). They have steep sides (greater than 25 degrees), and crater floors which lie above ground level. The two cones, with four smaller associated cones, align along a north-northwest line and comprise the Menan Complex.

The site is a popular tourist spot and very early on was earmarked as one of the thousands of good viewing sites for the 2017 eclipse. The state of Idaho was a popular choice mainly for its good weather prospects. In fact we had great weather throughout our holiday. Our trip began in Las Vegas, Nevada. We then visited The Grand Canyon (Colorado), Bryce Canyon (Utah), Idaho Falls (Idaho), Yellowstone Park and Jackson (Wyoming) and Salt Lake City (Utah). The trip was organised by Omega Holidays.

When our three coaches arrived hours before the eclipse the site was already overcrowded with Eclipse Watchers and their trucks, vans and cars. We thought we wouldn't be getting in! However, our trip organisers had already arranged previously for our designated coach park area to be fenced off. But it took the arrival of the local Sherriff and Park Ranger to get us through the hundreds of cars and pickup trucks, already in their place for the eclipse, to our allocated area.

The weather was fantastic. Clear Skies 28 degrees Celsius, Calm. Many seasoned Eclipse watchers had some serious equipment on hand to record the event, others had small telescopes with solar filters to view the spectacle directly. As this was to be my first successful Eclipse Trip, the first attempt being the infamous 1999 Eclipse in Cornwall, I just wanted to view the event through the obligatory Eclipse glasses, which were widely available of course, Cardboard glasses with Baader

Solar filter instead of spectacle lenses. But I did have a small Bridge Camera with me and took some photos on automatic but focused on infinity.

across the planet's surface.

Chasing the Total

Solar Eclipse from

of the Sun's outer atmosphere — the corona

to date and the first-ever thermal images

of Mercury, revealing how temperature varies

The local time for totality of the eclipse was at 11:32 am and it didn't seem long before eclipse time came. At about 10:17 someone said, "it's started", and sure enough looking through the eclipse glasses a tiny chunk of the top right-hand side of the Sun was "missing". The event had begun.

Lots of eclipse watchers were taking photos, videos, recording the event. In fact, this Eclipse was destined to be the most photographed and videoed eclipse of all time. The hours passed, and the daylight began to have an eerie feel about it. And it was getting colder. The Moon had now covered most of the Sun's disk. Slowly the Moon advanced over the Sun's disk. And then just over an hour later came second contact, totality had begun.

The diamond ring came and went. Then the Sun's disk was completely covered. At last, my first successful total solar eclipse. There was a dullness to the ambient light, but both north and south horizons had a strange sunset-like orange glow. A very eerie and quiet feel. I looked up to the right of the Sun at a bright object. This was Venus. Never seen at this high altitude in the sky. To the lower left of the Sun was the star Regulus, the brightest star in the constellation Leo. Then at just over 2 minutes from the start of the eclipse, the second diamond ring. Fantastic. The eclipse was over. The sky brightened and things got back to normal.

What an unforgettable event. The whole trip was very well organised. The weather was very cooperative.

So this is Solar eclipse number one in my book. Would I chase another one? Most definitely. I now know why thousands of people from all over the world chase eclipses to the far corners of the globe. You have to see one to fully understand this. When will my next one be? There is a chance of travelling to Chile in South America in July 2019. We'll have to wait and see.

Acknowledgements and Credits

Omega Holidays: www.omega-holidays.co.uk Volcanolive web site: www.volcanolive.com Time and Date web site: www.timeand date.com

Astronaut News Rob Wood

New Chief Astronaut

On 2 June 2017, NASA announced the appointment of Patrick Forrester as the new Chief of the Astronaut Office. He replaces Christopher Cassidy, who has held the position since July 2015. Cassidy will return to the astronaut corps and resume a candidacy for flight assignment.

Over the years, the time an astronaut spends as Chief Astronaut has varied. Recently, it has tended to be for three years but on this occasion, Cassidy has stood down after two. Forrester is the sixteenth Chief Astronaut. The first twelve were all pilot astronauts but from Peggy Whitson, the appointments have all been astronauts selected as mission specialists. This distinction of pilot and mission specialist astronauts ended with the 2009 astronaut selection because of the end of the Space Shuttle Programme so soon the Chief Astronaut will have been selected as simply an astronaut.

The list of chief astronauts includes some very famous names from the early days of the US space programme:

 Deke Slayton 	(1962-1963);
Alan Shepard	(1963-1969);
 Thomas Stafford 	(1969-1971);
 Alan Shepard 	(1971-1974);
John Young	(1974-1987);
 Daniel Brandenstein 	(1987-1992);
 Robert Gibson 	(1992-1994);
 Robert Cabana 	(1994-1997);
 Kenneth Cockrell 	(1997-1998);
 Charles Precourt 	(1998-2002);
 Kent Rominger 	(2002-2006);
 Steven Lindsey 	(2006-2009);
 Peggy Whitson 	(2009-2012);
Robert Behnken	(2012-2015)
 Christopher Cassidy 	(2015-2017)
Patrick Forrester	(2017-)

In his new role, Forrester will be responsible for managing Astronaut Office resources, operations and safety programmes. He will be involved in choosing crews for upcoming space missions and developing training procedures.

"Chris is an American hero," NASA's Director of Flight Operations Brian Kelly said. "He has been an exemplary leader of NASA's astronaut corps and has been instrumental in the integration of our entire flight operations as well as the selection of our newest astronaut class. His practical approach in tackling the many challenges that our astronauts encounter while living and working in space has been crucial to the continued success of our human spaceflight missions."

"I have known Pat for more than 20 years," Kelly said. "He will no doubt be an outstanding Chief of the Astronaut Office. Pat is a well-respected and proven leader who will capably guide our astronauts as they reach beyond low-Earth orbit."

Patrick Graham Forrester (Colonel. US Army, Ret.) was born on 31 March 1957 in El Paso, Texas. His father was a serving military officer who was a graduate of West Point, the most prestigious US Army military academy. Like his father, Patrick Forrester would also enter West Point. His academic achievements include a Bachelor of Science Degree in Applied Sciences and Engineering from the United States Military Academy, West Point, New York (1979) and a Master of Science Degree in Mechanical and Aerospace Engineering from the University of Virginia, Charlottesville (1989).

He was commissioned in the US Army following graduation from West Point in 1979. His varied army career saw him serve as a platoon leader, aviation company operations officer, assault helicopter battalion operations officer, helicopter pilot, instructor pilot, flight test engineer and test pilot. He attended the US Army Aviation School and was designated an Army Aviator in September 1980. In 1984, he was assigned to the 25th Infantry Division (Light), Schofield Barracks, Hawaii, as an operational helicopter pilot.

After his master's degree he worked at Edwards Air Force Base, California, as a flight test engineer with the Army Aviation Engineering Flight Activity group. In 1992, he graduated from the US Naval Test Pilot School at Patuxent River, Maryland and was then assigned as an engineering test pilot at the US Army Aviation Technical Test Center, Fort Rucker, Alabama.

He does not remember harbouring any thoughts of becoming an astronaut as a youngster, "I knew early on that I wanted to be in the military, that I wanted to go into the Army," he told a NASA interviewer years later. But it was only whilst he was an army officer that a new career became a goal. He was serving at an army base in Hawaii, when he read an article about Robert Stewart, the first army astronaut, and this awakened a new interest. "I love to fly and be in the Army and also, maybe, do something like be an astronaut and it was there that I started to apply and prepare myself. Once I latched onto that I really never let it go and pursued it through many interviews and applications."

He had already applied unsuccessfully a couple of times for the astronaut corps when he was given the opportunity to work for NASA as a representative of the US Army. This was too good a chance to miss and so in July 1993, he was detailed to NASA's Johnson Space Center as an aerospace engineer. He supported the work of the Astronaut Office and no doubt this experience helped his CV look more attractive to NASA. He still kept his hand in with flying and flew with the Texas National Guard out of Ellington Field Joint Reserve Base, Houston. He remained on active duty with the army until October 2005.

He was called for the week long interview and medical examination process as a semi-finalist for NASA's 1994 astronaut class (number 15), and although not in the final selection, he was definitely getting closer. He was selected as a mission specialist astronaut in 1996 (NASA Astronaut Group 16). He became eligible for flight assignment after successfully completing two years of basic training.

He had a number of ground assignments for the Astronaut Office including as a member of the Astronaut Support Team at the Kennedy Space Center, as an assistant to the Director, Flight Crew Operations and CapCom duties for ISS and shuttle missions. He flew as a mission specialist on three shuttle missions: STS-105 (2001), STS-117 (2007) and STS-128 (2009).

It was rare that a shuttle got off the pad on the planned date but neither STS-105 or STS-128 suffered from significant delays. When he was named to STS-105 on a NASA press release dated 1 December 2001 it was aimed at a launch in June 2001. For STS-128 the release was dated 16 July 2008 and launch was targeted for 30 July 2009. STS-105 got off the ground on 10 August 2001 and STS-128 on 28 August 2009. Not too long after the target dates on crew announcement dates. In shuttle terms delays of one or two months were minimal. However, STS-117 was a real doozy. It was seven years between his assignment to STS-117 and actual lift-off.

On 15 August 2002, NASA announced his assignment to STS-117, then looking at an autumn 2003 flight. On 1 February 2003, the Space Shuttle Columbia broke up on re-entry killing all seven crew members. The next shuttle spaceflight did not start until 26 July 2005. Because of the delays and changes in crewing priorities, NASA made a new crew announcement for STS-117 on 9 February 2005, still including Forrester, but now with the mission looking to fly in 2006. But the delays continued. By March of 2006, the mission was now due to start in January 2007. Then it was March 2007. On 26 February 2007 a hail storm damaged STS-117's External Tank causing further delays. Eventually, the flight took place in June 2007.

He was MS-1 for STS-105 Discovery (10-22 August 2001), which delivered the third ISS expedition crew to the station and returned to Earth the second crew. The mission also arrived with supplies and equipment for the station carried by the Italian built 'Leonardo' Multi-Purpose Logistics Module (MPLM). Forrester conducted two spacewalks during the flight and was also the prime robotic arm operator to berth and unberth the MPLM between the shuttle's payload bay and the station's Unity module.

STS-117 Atlantis (8-22 June 2007) carried the second starboard truss segment; the third set of the United States solar arrays, batteries and associated equipment for the ISS. One member of the ISS residency crew was swapped out. Forrester was again MS-1 and part of the EVA team completing two further spacewalks. He again conducted robotic arm operations.

STS-128 Discovery (28 August – 11 September 2009) must have seemed like normal day-to-day business for Forrester. For the third time he was MS-1 and also on robotic arm duties. The mission also saw his second time in the company of the Leonardo MPLM. Amongst the equipment carried by Leonardo was the interestingly named COLBERT or to give it its full name Combined Operational Load Bearing External Resistance Treadmill. It was named after a TV show, 'The Colbert Report' and its host Stephen Colbert. This was also the last shuttle flight to rotate an ISS residency crew member.

In 2011, he stood down as an active astronaut and joined the ranks of NASA's management astronauts. At the time of his appointment as Chief Astronaut he had logged more than 5,300 hours in over 50 different aircraft.

Christopher John 'Chris' Cassidy (Captain, USN) was born on 4 January 1970 in Salem, Massachusetts. His interesting and varied career saw him serving: as a US Navy SEAL in combat zones, as a mission specialist on the Space Shuttle, as a flight engineer on the ISS swapping food with his Russian colleagues, and as the top dog in the Astronaut Corps. His academic achievements include a Bachelor of Science degree in Mathematics from the US Naval Academy (1993). Seven years later he obtained a Master of Science degree in Ocean Engineering from the Massachusetts Institute of Technology (2000).

Following graduation from the Naval Academy he married and then moved to San Diego where he underwent Navy SEAL training. He was the Honour graduate of Basic Underwater Demolition/SEAL Class 192. He was then assigned to SEAL Delivery Vehicle (SDV) Team TWO at the Naval Amphibious Base, Little Creek, Norfolk, Virginia, where he was based for about four years. He accumulated more than 200 hours underwater as pilot/navigator/mission commander of the two-man flooded SDV submersible.

After his two years at graduate school in Massachusetts, he was posted as a platoon commander in SEAL Team THREE based at the Naval Amphibious Base, Coronado, California. The team was preparing for a scheduled deployment when the September 11 (2001) attack occurred. They soon found themselves in Afghanistan. Cassidy was awarded the Bronze Star with combat 'V' and Presidential Unit Citation for leading a nine-day operation at the Zhawar Kili cave complex very close to the Pakistan border. He was awarded a second Bronze Star in 2004 for combat leadership service in Afghanistan.

In 2002 he was assigned back to Norfolk where he served as the Executive Officer and Operations Officer of Special Boat Unit TWENTY. He had already unsuccessfully applied for NASA's astronaut class of 2000 but decided to try again whilst based at Norfolk. He was interviewed by NASA in September 2003 and almost immediately afterwards deployed overseas again for a six-month tour. On the Monday after the weekend he returned home he received the telephone call from the then Astronaut Chief Kent Rominger asking if he was still interested in working for NASA. A month later, the Cassidy family had sold their house and were on the move to Houston.

He was selected as a mission specialist astronaut in 2004 (NASA Astronaut Group 19). He successfully completed basic training in

February 2006 which made him eligible for technical duties in the Astronaut Office and flight assignment. He worked as a CapCom in Mission Control from 2006 to 2008.

NASA's news release of 12 February 2008 named Cassidy to STS-127, then targeted for launch in 2009. In July 2008 NASA said that the launch of STS-127 was due on 15 May 2009 but by 30 April 2009 this had been pushed further back to 13 June 2009. The attempt to launch on 13 June 2009 was scrubbed due to a gaseous hydrogen leak and the same thing happened on 17 June 2009. In the event launch of Cassidy's first spaceflight did not take place until 15 July 2009 and then only after three further scrubs due to weather conditions on consecutive days from 11 through 13 July 2009.

The mission of STS-127 Endeavour (15- 31 July 2009) delivered the Japanese-built Exposed Facility and Experiment Logistics Module Exposed Section to the ISS. With these, the crew were able to complete the construction of Kibo. Kibo is the Japan Aerospace Exploration Agency's ISS Experiment Module. Cassidy was MS-1 and conducted three spacewalks whilst the shuttle was docked to the station.

On 18 February 2011, NASA released the news that Cassidy would fly an ISS residency mission. He was named to ISS Expeditions 35/36 with his flight due to commence in March 2013. From Russian sources, his name had been linked to this assignment in December 2010. Before his second spaceflight he would serve in a back-up flight engineer role for Soyuz TMA-06M/ISS33/34 which launched on 23 October 2012.

For his second spaceflight, Soyuz TMA-08M/ISS-35/36 (29 March – 11 September 2011), Cassidy would serve as a flight engineer for both the Soyuz spacecraft and the space station. The Soyuz used a new 6-hour fast rendezvous flight profile to the ISS. It had been trialed on three unmanned Progress M resupply runs but this was its first use for a manned mission. The mission would last for 166 days before he returned to Earth in central Kazakhstan in the descent module of the Soyuz.

During his time as an ISS crewmember he gained a taste for Russian food. "One of the Russian astronauts really liked our chocolate pudding," said Cassidy. "I would trade my pudding serving for their veal that I really liked." He also participated in three spacewalks but it was the third on 16 July 2013 that produced the most excitement and publicity.

The EVA began at 14:57 (Moscow Time). With Cassidy was Italian/ ESA astronaut Luca Parmitano. Their main tasks were to prepare the ISS for a new Russian module and perform additional installations and replacements on the station's exterior. About 44 minutes into the spacewalk Parmitano reported water inside his helmet.

As the amount of water increased the EVA was terminated but as Parmitano made his way back to the airlock the situation got worse. Parmitano suffered from impaired breathing and visibility, and had communication problems. Parmitano entered the airlock first but had to wait several minutes for Cassidy to join him and start closing the airlock hatch. Repressurization started but all the time Parmitano's situation was worsening. He had lost his audio communications and had to signal to Cassidy by hand. Cassidy reported that, "He looks fine. He looks miserable - but OK."

With repressurization complete the internal hatch was opened and the rest of the ISS crew of US and Russian astronauts helped expedite Parmitano's progress out of the airlock and quickly started to remove his helmet. Cassidy who was now unable to assist further waited calmly in the airlock. Capcom Shane Kimbrough said, "Hey Chris, just hang tight for a bit." Cassidy replied, "No problem. I'm in no rush. I've got a ring side seat."

An hour and 41 minutes after the EVA had begun, Parmitano's helmet was off. NASA's PAO said, "...neither astronaut was in serious danger..." on the live TV broadcast as the astronauts continued to help Parmitano out of his spacesuit. The PAO was wrong or making some strange usage of the phrase 'neither astronaut was in serious danger' that I had been previously unaware of. In fact it was a close call for Parmitano who was at genuine risk of drowning.

Following his second spaceflight, Cassidy was assigned as Chief of Extravehicular Activity and Robotics for the Astronaut Office before

moving into the role of a Deputy Chief of the Astronaut Office in March 2015. In July 2015, he became Chief Astronaut.

He is not the only SEAL to be admitted into NASA's astronaut corps. Bill Shepherd, who also served in Special Boat Unit TWENTY, joined the astronaut team in 1984. He made four spaceflights and was the first ISS commander. A third Navy SEAL, Jonny Kim, is currently in ascan training having been selected with the 2017 NASA astronaut class.

ISS Crewing Updates

What would an Astronaut News be like without an ISS crewing update? For the fourth issue running and for the eighth time in the last ten we have an item under the update heading. This news comes under the sub heading of 'officially unofficial'. Two astronauts who have not been named to crews by their space agencies (a not totally accurate statement as I will soon explain) have started water survival training in Russia as part of an ISS crew.

This update actually has a start to the story on 18 January 2017. This was when ESA's annual press briefing took place. ESA Director General Jan Woerner spoke to the media at ESA Headquarters in Paris, and provided an overview of ESA's achievements in 2016 and the opportunities ahead in 2017. He also provided an update on ESA's astronaut team. With ESA's contribution to the ISS programme confirmed through to 2024, Woerner said that they would be looking to get all the 2009 astronaut selection a second flight, noting that Alexander Gerst had already been selected to fly in 2018 and then said that "Luca Parmitano will fly in 2019." He did not give any details of the actual mission.

Fast forward four months and on 16 May 2017 the Yuri Gagarin Cosmonaut Training Centre reported Luca Parmitano had been presented to their management and staff prior to commencing his training at the centre. It was not long before the Yuri Gagarin Cosmonaut Training Centre gave us another name. On 6 June 2017, the Yuri Gagarin Cosmonaut Training Centre announced that NASA astronaut Anne McClain had been presented to their management and staff before starting her training.

On 14 June 2017, a member of the Novosti Kosmonavtika forum with a very good record for accurate information (forum name 'Shams') reported that Luca Parmitano and Anne McClain had been assigned as flight engineers to Soyuz MS-13 due to launch in September 2019 and as back-ups for Soyuz MS-11. Although Shams did not confirm this, those positions would equate to them flying on ISS Expeditions 59/60.

Partial confirmation of Luca Parmitano and Anne McClain's assignment together came on 30 June 2017 when the Yuri Gagarin Cosmonaut Training Centre reported both had started water survival training. Pictures showed two crews. The first was Serena Auñón-Chancellor. Oleg Kononenko and David Saint-Jacques, who we already know are an ISS crew (ISS-58/59) and the second was Anne McClain, Aleksey Khomenchuk and Luca Parmitano. Khomenchuk is described as an instructor trainer but he was a candidate cosmonaut previously. He had been selected as a cosmonaut candidate in 2010 but did not pass basic training. He took up other work at the training centre. Trainers are often included in these exercises where the whole crew is yet to be appointed.

Luca Salvo Parmitano (Lieutenant Colonel, Italian Air Force) was born on 27 September 1976 in Paternò, Italy. His parents were both teachers but he had no ambitions to join them. "I grew up with the dream of being an astronaut," he told a NASA interviewer. He describes an early memory, "about three or four-years-old, no older than that," telling a swimming pool instructor that he wanted to be an astronaut. He graduated from high school in 1995 and then attended the Italian air force academy and university.

He received a Bachelor of Science degree in Political Sciences from the University of Naples Federico II, Italy, with a thesis on international law in 1999 and the following year graduated from the Accademia Aeronautica (Italian Air Force officer training academy), in Pozzuoli, Italy. He then attended Euro-NATO Joint Jet Pilot Training at Sheppard Air Force Base, Texas, USA, which he successfully completed in 2001.

He was posted to the 13th Fighter-Bomber Squadron, of the 32nd Wing at Amendola Air Base, Italy, where he flew the AMX International AM-X single-engine jet ground attack aircraft from 2001 to 2007. In 2007, he was selected by the Italian Air Force to become a test pilot. He attended the French Test Pilot School, Ecole du Personnel Navigant d'Essai et Réception (EPNER) at Istres-Le Tubé Air Base, France, where he trained as an experimental test pilot. In 2009, he received a Master of Science degree in Experimental Flight Test Engineering at the Institute Superieure de l'Aeronautique et de l'Espace in Toulouse, France.

On 10 April 2008, ESA announced a new astronaut recruitment round and he was one of almost 10,000 people who registered as candidates through the ESA website prior to the closing date of 18 June 2008. Of these 8413 fulfilled the initial application criteria. Based upon the initial announcements they were competing for four vacancies, although ultimately six would be chosen with a seventh activated in 2016. On 20 May 2009, ESA named the original six including Parmitano. He officially joined ESA in September 2009 to commence basic training. This was successfully completed in November 2010.

On 18 February 2011, ESA announced his assignment to his first spaceflight. He was the first of his group to be assigned and fly in space. Before making his spaceflight he served in back-up roles for Soyuz TMA-07M/ISS34-35, which launched on 19 December 2012. His flight was Soyuz TMA-09M/ISS36-37 (29 May – 11 November 2013). He served as a flight engineer for both the Soyuz spacecraft and the ISS.

He spent 166 days in space conducting over 20 experiments and took part in two spacewalks. However, the second spacewalk did not go according to plan. The EVA began at 14:57 on 16 July 2013 (Moscow Time). His partner was NASA astronaut Chris Cassidy. Their main tasks were to prepare the ISS for a new Russian module and perform additional installations and replacements on the station's exterior. About 44 minutes into the spacewalk Parmitano reported water inside his helmet.

The EVA was terminated but as Parmitano made his way back to the airlock the situation got worse. He suffered from impaired breathing and visibility, and had communication problems. The water covers his nose and as the sun sets his vision, already compromised by the water, goes almost completely. He uses his tether to feel his way towards the airlock.

As he moves, he thinks about how to eliminate the water if it reaches his mouth. In his own words, "The only idea I can think of is to open the safety valve by my left ear. If I create controlled depressurisation, I should manage to let out some of the water, at least until it freezes through sublimation, which would stop the flow. But making a 'hole' in my spacesuit really would be a last resort."

He reaches the airlock but has to wait for Cassidy. Once inside he initially can hear Karen Nyberg, a NASA astronaut inside the space station, but she cannot hear him. Cassidy joins him and as repressurization begins the water is now inside his ears and he loses all communication. He would later write that with the start of repressurization, "I know that if the water does overwhelm me I can always open the helmet. I'll probably lose consciousness, but in any case that would be better than drowning inside the helmet."

Once inside, Karen Nyberg got his helmet off and Fyodor Yurchikhin and Pavel Vinogradov, two Russians cosmonauts who were ready to do whatever they could to help, handed him towels. For more on the drama of this spacewalk see the item on New Chief Astronaut (Chris Cassidy's biography) at the top of this issue of Astronaut News.

In his blog, Parmitano said, "Space is a harsh, inhospitable frontier and we are explorers, not colonisers. The skills of our engineers and the technology surrounding us make things appear simple when they are not, and perhaps we forget this sometimes. Better not to forget."

Anne Charlotte McClain (Major, US Army) was born on 7 June 1979 in Spokane, Washington. She spent a year in the Reserve Officers' Training Corps (ROTC) programme at Gonzaga University before attending the US Military Academy at West Point, New York. The ROTC is a military scholarship programme funding students in return for military service following graduation. She graduated from West Point in 2002 with a Bachelor of Science degree in Mechanical/Aeronautical Engineering.

She was one of the army's top softball players and during her time at West Point was a member of the Army's West Point Black Knights softball team. She was a three-time Patriot League Academic Honor Roll selectee (1999, 2001 and 2002) and played with two Black Knights' squads that advanced to the Softball Championship National Collegiate Athletic AssociationTournament. Not content with being a top softball player she also played Rugby and was part of the USA Rugby Women's National Team (2004 to 2006, and 2010 to 2012) and Captain of USA Rugby South Women's XV All-Stars (2009 to 2011).

She received a Marshall Scholarship in 2002, which she used to fund her master degrees in the United Kingdom. The Marshall Scholarship selects about 40 (37 in the year McClain was accepted) US students each year and is provided by the UK Parliament. It has its origins in the post-World War Two Marshall Plan, via which the USA helped Europe recover from the war. The scholarship was created as a gift in recognition of this. McClain spent three years in the UK and received a Master of Science degree in Aerospace Engineering from the University of Bath in 2004 and a second Master of Science degree in International Security from the University of Bristol in 2005.

She was commissioned as an Army officer in 2002 before attending graduate school in the UK. Following graduate school she underwent Army flight training and qualified as a Bell OH-58D Kiowa Warrior, single-engine, single-rotor, helicopter pilot, which is used for armed reconnaissance and ground combat support. She was assigned to the 2nd battalion of the 6th Calvary Regiment and in July 2006 was deployed to Iraq as part of the US occupation forces. Over the next 15 months she flew 216 combat missions accumulating about 850 hours in the air.

She applied to join the 2009 NASA astronaut group but was not called for the interview stage prior to final selection. In June 2009 she was assigned to the US Army Aviation Center of Excellence at Fort Rucker in Alabama where she qualified as a flight-instructor on the Kiowa Warrior. When NASA called for more astronauts towards the end of 2011 she again applied. In the meantime she continued her assignment at Fort Rucker until she was accepted into the US Naval Test Pilot School at Patuxent River, Maryland. She started training there in July 2012 and graduated on 15 June 2013.

On 6 June 2013, just prior to her graduation from Pax (as the navy base in Maryland is often called) the astronaut applicants heard of their fate. McClain received the telephone call from NASA enquiring whether she was still interested in the position of astronaut. She said "I couldn't stand, I couldn't breathe and then there were tears." But she recovered enough to joke about checking her schedule before quickly laughing and saying "Of course." On 17 June 2013 NASA announced the selection of its 21st group of astronauts. She was one of eight selected. She reported to the JSC in August 2013 to begin basic training. She successfully completed ascan training in July 2015.

Status of ESA's Astronaut Corps

In the previous item and the March/April 2017 edition of Capcom regarding ESA supplementing its Astronaut Corps, I mentioned ESA Director General Johann-Dietrich Woerner's press briefing at ESA Headquarters in Paris on 18 January 2017. During the briefing, he noted that all six of the flown astronauts selected in 2009 were either assigned to a second flight or had an expectation of flying for a second time.

He noted that Matthias Maurer was an activated reserve from 2009 and will be assignable in the future. Also showing in the power point presentation slide he was using was three earlier astronauts that were still around: Paolo Nespoli, who was launched on his third mission on 28 July 2017; Pedro Duque who was said to be assignable for a third flight; and Roberto Vittori who was said to be not active at present but would like to return to that status.

He did not mention any other ESA astronauts. ESA's own website is not totally clear on which of the pre-2009 astronauts are still active and unfortunately the biography pages are updated intermittently, which does not help. For example, Jean-François Clervoy's current assignment is noted to be as a member of ESA's Astronaut Corps, based at the European Astronaut Centre in Cologne, Germany, but this was last updated in December 2014.

We could infer that those listed under the heading 'Pre-2009 ESA astronauts' are still active or could return to active status, which gives us ten astronauts: Jean-François Clervoy, Pedro Duque, Reinhold Ewald,

Léopold Eyharts, Christer Fuglesang, André Kuipers, Paolo Nespoli, Hans Schlegel, Roberto Vittori and Frank De Winne.

The always useful (but not infallible) statistical website Spacefacts has Ewald and De Winne as inactive. Ewald at some undetermined date in the period 2000 to 2009 and De Winne on 1 August 2012 (this is the date he was appointed Head of the European Astronaut Centre, although I am not sure why this precludes him from flying again). The other eight are still listed as active by Spacefacts.

Jumping back to the ESA press briefing in January 2017, it is of course possible that Director General Woerner mentioned three pre-2009 astronauts because they are the only ones from that era still in the frame for flight assignment. Do we have any evidence for this? Yes, but mostly circumstantial.

The first point is, if others are still in the frame why did Director General Woerner not mention them. Of course the answer to that might simply be that other names were not put in his power point presentation that presumably was prepared by an aid. Secondly, there is the age question for some. Schlegel (born 1951) and Ewald (1956) seem to getting a little old to start an ISS training cycle. But at the rate astronaut ages are going up (Nespoli born 1957 was already 60 when he started his third mission), I am not sure how safe it is to go down that road.

Duque (1963) and Vittori (1964) are the youngest of the pre-2009 astronauts and this is consistent with them being active whilst the others have ages which support the opposite. In age order: Fuglesang (1957), Eyharts (1957), Kuipers (1958), Clervoy (1958) and De Winne (1961). As I have previously said in relation to Schlegel and Ewald are they not getting a little too old to start an ISS training cycle. In a private (but not meant to be secret) conversation I had with an 'in the know' person after his second flight in 2012, I was told that Kuipers would not be flying again.

Another point is the availability of flight opportunities in the future. If we assume one flight to the ISS each year, as recent history suggests, then there are not enough positions for all the astronauts assuming the ISS ends in 2024 as per current plans (I think it will get another four years but let us discount that for the purposes of this discussion).

But, it is not as simple as that. We can also add the possibility of extra flights if the Russians continue with their lower ISS crew numbers and NASA do not take up all the slots. There are the commercial crew vehicles which should eventually open up some extra opportunities both of a long duration nature and short visiting missions. There is also the rumoured joint mission with the Chinese, but that is certainly several years into the future (my guess is 2024).

Taking into account the possible extra missions, there are probably enough flight opportunities for the seven 2009 (sic) astronauts to fly again plus Duque and Vittori. It is no stretch of the imagination to suggest Nespoli has just started his final spaceflight.

An extra point is why activate Matthias Maurer if there are plenty of astronauts available? Is this not suggestive of a lower number of active astronauts? I would argue this is definitely possible.

It all adds to the conclusion that there are currently ten active[ish] ESA astronauts as given by Director General Woerner. The seven 2009 (and supplemental) astronauts: Samantha Cristoforetti (representing Italy), Alexander Gerst (Germany), Matthias Maurer (Germany), Andreas Mogensen (Denmark), Luca Parmitano (Italy), Timothy Peake (UK) and Thomas Pesquet (France), and the three pre-2009 astronauts: Pedro Duque (Spain), Paolo Nespoli (Italy) and Roberto Vittori (Italy). No doubt the next ESA announcement will show how wrong I am. Watch this space (pun intended).

One final question is when will ESA make a new astronaut selection? There had been an expectation of an ESA astronaut recruitment in 2019 but with the activation of Matthias Maurer from reserve status it is not clear how plans will be effected. If ESA continue in the human spaceflight business after 2024, then they will need some new astronauts before then. I still do not think that 2019 will be that wide off the mark allowing for training before flight eligibility etc., especially if there is a joint mission with the Chinese in about 2024 which will require two astronauts (prime and back-up). If my arm is twisted then I will go with 2020 for a new group to be named.

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

After the announcement of new Canadian astronauts in the last issue we have news of one of the old timers. Dafydd Williams is currently CEO and President of Southlake Regional Health Centre in Newmarket, Ontario, but is planning to retire by the end of 2017. He has been in his current position since 2011. He is a medical doctor by profession. He was born on 16 May 1954 in Saskatoon, Saskatchewan. He was a Canadian Space Agency astronaut from 1992 to 2008 and made two spaceflights both on the US Space Shuttle: STS-90 (1998) and STS-118 (2007). He made three EVA's on his second flight and holds the record for the most Canadian EVA's and cumulative time on EVA.

Continuing the theme of retired Canadian astronauts, Julie Payette has been appointed the 29th Governor General of Canada. Announced on 13 July 2017, she will take over the position from September 2017. Although in reality a largely ceremonial role, as the representative of Her Majesty Queen Elizabeth II, she is technically the Head of State (because the Queen is Head of State). Her duties will include: serving as commander-in-chief of the Canadian Armed Forces; representing Canada at events, ceremonies and official visits at home and abroad; summoning, suspending and dissolving Parliament; and presiding over the swearing-in of the prime minister and giving royal assent to acts of Parliament. She was a CSA astronaut from 1992 to 2013 and flew twice on the US Space Shuttle, STS-96 (1999) and STS-127 (2009). Both flights visited the ISS. She was the first Canadian astronaut to board the ISS. More recently she has been Chief Operating Officer of the Montréal Science Centre and a member of the Canadian Olympic Committee.

Shuttle Mission Specialist and ISS Astronaut Retires

On 21 June 2017, NASA released the news that Rick Mastracchio had left the agency effective 16 June 2017. He had worked for NASA since 1990 and joined the astronaut corps in 1996 going on to make four spaceflights. "Rick is a classmate and a friend and he has done great work for NASA, both in space and on the ground," said Chief Astronaut Pat Forrester, who was selected as an astronaut in the same class as Mastracchio. "His breadth of experience over three decades in human spaceflight will serve him well as he moves on to his next endeavour."

Slightly jumping the gun on NASA's announcement was Orbital ATK who, two days previously, confirmed he was joining them as Senior Director of Operations for Commercial Resupply Services (CRS) in their Space Systems Group. As a member of the Advanced Programs Division's Human Space Systems team based in Dulles, Virginia, Mastracchio will be responsible for managing the CRS Mission and Cargo Operations teams. He will also support other Human Space Systems programmes, including Orbital ATK's exploration pursuits beyond low earth orbit.

"We are thrilled to welcome Rick Mastracchio to Orbital ATK," said Frank DeMauro, Vice President and General Manager of Orbital ATK's Advanced Programs Division. "With his experience as an astronaut and his time spent on the International Space Station, Rick brings a unique understanding of human space flight, making him an invaluable resource for our human space flight endeavours."

Orbital ATK is a global leader in aerospace and defence technologies. The company designs, builds and delivers space, defence and aviation systems for customers around the world, both as a prime contractor and merchant supplier. Its main products include launch vehicles and related propulsion systems; missile products, subsystems and defence electronics; precision weapons, armament systems and ammunition; satellites and associated space components and services; and advanced aerospace structures. Headquartered in Dulles, Virginia, Orbital ATK employs approximately 12,500 people in 18 states across the US and in several international locations. 11 February 1960. His academic achievements include a Bachelor of Science degree in Electrical Engineering/Computer Science from the University of Connecticut (1982), a Master of Science degree in Electrical Engineering from Rensselaer Polytechnic Institute (1987) and a Master of Science degree in Physical Science from the University of Houston-Clear Lake (1991).

He worked in private industry before joining NASA full-time. From 1982 to 1987, he was with Hamilton Standard in Connecticut as an engineer in the system design group. From 1987, he was with the Rockwell Shuttle Operations Company conducting contact operations at the Johnson Space Center. In 1990, he joined NASA as an engineer in the Flight Crew Operations Directorate.

His duties as an engineer with NASA included the development of space shuttle flight software requirements, the verification of space shuttle flight software in the Shuttle Avionics Integration Laboratory, and the development of ascent and abort crew procedures for the Astronaut Office. From 1993 to 1996, he worked as an ascent/entry Guidance and Procedures Officer in Mission Control. During that time, he supported seventeen missions as a Flight Controller.

He made his first attempt to be an astronaut with the 1987 NASA selection (NASA Group 12) and made further tries each time the chance came. He made it twice to the interview and examination stage (the 1992 and 1995 selections - NASA Groups 14 and 15). He was finally selected as an astronaut in 1996 (NASA Group 16). In his own words, "it took me about fourteen years of working as an engineer, three college degrees, nine years of astronaut applications, and three interviews to finally get selected. It's perseverance but I had a great job here at the Johnson Space Center working as an engineer so whether I got accepted or not, I had a great job."

After the naming ceremony for the group in April 1996 he reported for ascan training in August 1996. He successfully completed a two year training and evaluation period, which qualified him for technical assignments for the Astronaut Office and flight assignment. He has since logged 227 days in space on four spaceflights, including 53 hours in nine spacewalks. His time on spacewalks puts him at sixth on the list of most cumulative time spent on EVA and only five have conducted more individual EVA's (as of end of July 2017).

During his time as an astronaut he served in a number of ground roles including working technical issues for the Astronaut Office's Computer Support Branch, Space Station Operations and EVA Branch. He has also been a CapCom. He served as the Display Design Lead for the space shuttle cockpit avionics upgrades in 2003. From 2004, he worked various Constellation and Orion tasks including Cockpit Design Lead, and Constellation Deputy Branch Chief.

He first flew in space as MS-2 on STS-106 Atlantis (8-20 September 2000), followed by another stint as MS-2 for STS-118 Endeavour (8-21 August 2007). Part of the role of MS-2 is to act as the launch and reentry flight engineer assisting the commander and pilot. He was also the primary robotic arm operator for STS-106. His third mission was as MS-1 on STS-131 Discovery 5-20 April 2010). All three missions flew to the ISS delivering supplies, equipment and conducting construction tasks. He made three spacewalks on each of his second and third flights.

His final spaceflight was Soyuz TMA-11M/ISS38-39 (7 November 2013 – 14 May 2014). He was a Soyuz and ISS flight engineer. He conducted three spacewalks during the mission. Prior to this flight he served on the back-up crew for Soyuz TMA-09M/ISS36-37 (launched on 29 May 2013). In 2015, he moved to the ranks of management astronauts.

Goddard Dedicates Hyperwall to Piers Sellers

On 17 July, the NASA Center for Climate Simulation's Data Visualization Theater was dedicated to Piers Sellers, a climate scientist and former astronaut, who died in December 2016. It will now be known as the NASA Center for Climate Simulation Dr. Piers J. Sellers Data Visualization Theater. The theatre is at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

The theatre features a 20-foot by 6-foot 10-inch multi-screen visualization wall, also known as a hyperwall. The NASA Center for

Richard Alan Mastracchio was born in Waterbury, Connecticut, on

Climate Simulation's hyperwall combines 15 55-inch high-definition LCD screens with very narrow bezels, resulting in an almost seamless surface of more than 31 million pixels.

The hyperwall is a flexible environment for displaying high-definition movies of simulation results, data visualizations, animations, and other imagery. Not only can the wall display high-definition movies (1280x720 and 1920x1080), but also data and simulation results that are much higher than traditional high-definition resolution, up to 9600x3240.

The wall can show a single visualization across all 15 screens or up to 15 or more visualizations at once for comparison. Interactive capabilities are under development. The hyperwall is a joint effort of the NASA Center for Climate Simulation and NASA's Scientific Visualization Studio.

"Piers had a way with words," Goddard Center Director Chris Scolese said. "He had a way to explain things that were not only understandable, but fun and hopeful. He left that message with every person who walked into this room and heard what he had to say, from 10-year-old children all the way up to the largest skeptic."

"He loved the science, he loved the people of Goddard," Director of Sciences and Exploration Colleen Hartman said. "He was committed to saving our Earth and very hopeful he believed that technology was going to make that happen and that people were going to understand it. It's everyone here who will be able to explain that to the rest of the world in Piers' absence to make sure we protect the Earth."

Sellers died on 23 December 2016 in Houston as a result of pancreatic cancer. He had been diagnosed with stage four of the disease in October 2015. At the time of his death Goddard Center Director Chris Scolese made a statement which I repeat below.

"Piers came to Goddard in 1982 from his native Britain and ultimately left a legacy that few can claim. His career path took him from scientist, to astronaut, and back to his roots as a leader in Goddard's Sciences and Exploration Directorate.

After learning he had pancreatic cancer more than a year ago, Piers' optimistic take on life – well-known within the gates at Goddard – inspired people around the world. He spoke eloquently about his confidence in humanity's ability to confront the challenges of climate change, even as he faced his own terminal diagnosis.

Piers' contributions to Earth science are beyond significant. His Simple Biosphere Model was the first to realistically simulate the interaction of global photosynthesis and Earth's climate. The focus of research throughout his career, his first-author papers on biosphere-climate interactions have been cited thousands of times. He led major field campaigns, FIFE and BOREAS, that combined ground, airborne, and satellite measurements at an unprecedented scale. He was the first project scientist of the Terra mission, which remains healthy in orbit today, 17 years after launch.

When the opportunity arose, Piers made good on a childhood dream and was accepted to NASA's astronaut corps. On missions STS-112, 121, and 132, he helped complete construction of the International Space Station, and gained the perspective of seeing Earth from space that he would talk about for years to come.

In 2011, we at Goddard were fortunate that Piers chose to return to help lead the Sciences and Exploration Directorate and Earth Sciences Division. With wit and humor, and yet a razor-sharp focus on the task at hand, Piers has helped energize Earth science at Goddard in recent years.

We remember Piers as an exceptional scientist and leader, but most importantly as an inspiring human being. He could make you think anything was possible, was always up for the adventure, and would remind you along the way how lucky we are to do the work we do here at Goddard."

Piers John Sellers was born on 11 April 1955 in Crowborough, Sussex. With a doctorate in Biometeorology from Leeds University (1981) behind him he moved to the States (1982) and took up employment with NASA at Goddard. He became a naturalised US citizen (1991), making him eligible to apply for NASA's astronaut corps. He was selected as an astronaut in 1996 (NASA Group 16) and made three spaceflights. He was MS-1 on STS-112 Atlantis (2002), MS-4 on STS-121 Discovery (2006) and again MS-4 for STS-132 Atlantis (2010). All three missions visited the ISS and during the first two flights he made three EVA's on each, accumulating 41 hours of spacewalk time.

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.

Tim Peake, Helen Sharman and Al Worden: 28 September 2017 at New Scientist Live, ExCeL, London.

Al Worden: 7 October 2017 at National Space Centre, Leicester.

Al Worden: 9 October 2017 a Dark Sky Wales presentation in Aberdare, Wales.

Al Worden: 14 October 2017 – afternoon and evening events in Sheffield (Sheffield Hallam University and Curzon Cinema).

Helen Sharman: 26 October 2017 at Norwich Cathedral as part of Norwich Science Festival.

Bruce McCandless: 3-4 November 2017 with Space Lectures events in Pontefract.

Chris Hadfield: 12 February 2018 at Mayflower Theatre, Southampton.

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

Bits & Pieces

1/ On 10 June 2017, the U.S. Navy commissioned the USS Gabrielle Giffords, an Independence-class littoral combat ship named after the former member of the US House of Representatives who was seriously wounded in an assassination attempt in 2011. She is also the wife of former NASA astronaut Mark Kelly who made four space shuttle flights. A littoral combat ship usually conducts operations close to shore and in old fashioned terminology could be called a corvette.

2/ On 17 July 2017, KHOU 11 News Houston tweeted a picture with the comment "SUV lands on roof of St Louis home." This led to a twitter response of "I'd ask for a refund on your navigation system. Also, might check into increasing your thrust to weight ratio..." from former NASA astronaut Clay Anderson.

3/ On 3 August 2017, the Scripps Institution of Oceanography named former NASA astronaut and Administrator Charles Bolden as the 2017 recipient of the Nierenberg Prize. The prize is normally awarded annually for outstanding contributions to science in the public interest. The prize was created through a gift from the Nierenberg family to honour the memory of William A. Nierenberg, (1919-2000), a renowned national science leader who served Scripps Oceanography as director from 1965 to 1986. Bolden is the first astronaut to receive the award.

NASA's James Webb Space Telescope to be Launched Spring 2019

NASA's James Webb Space Telescope now is planning to launch between March and June 2019 from French Guiana, following a schedule assessment of the remaining integration and test activities. Previously Webb was targeted to launch in October 2018.

"The change in launch timing is not indicative of hardware or technical performance concerns," said Thomas Zurbuchen, associate administrator for NASA's Science Mission Directorate at Headquarters in Washington. "Rather, the integration of the various spacecraft elements is taking longer than expected."

As part of an international agreement with the ESA (European Space Agency) to provide a desired launch window one year prior to launch, NASA recently performed a routine schedule assessment to ensure launch preparedness and determined a launch schedule change was necessary. The careful analysis took into account the remaining tasks that needed to be completed, the lessons learned from unique environmental testing of the telescope and science instruments at NASA's Goddard Space Flight Center in Greenbelt, Maryland, and the current performance rates of integrating the spacecraft element.

Testing of the telescope and science instruments continues to go well and on schedule at NASA's Johnson Space Center in Houston, Texas. The spacecraft itself, comprised of the spacecraft bus and sunshield, has experienced delays during its integration and testing at Northrop Grumman in Redondo Beach, California.

The additional environmental testing time of the fully assembled observatory--the telescope and the spacecraft--will ensure that Webb will be fully tested before launching into space. All the rigorous tests of the telescope and the spacecraft to date show the mission is meeting its required performance levels.

Existing program budget accommodates the change in launch date, and the change will not affect planned science observations.

"Webb's spacecraft and sunshield are larger and more complex than most spacecraft. The combination of some integration activities taking longer than initially planned, such as the installation of more than 100 sunshield membrane release devices, factoring in lessons learned from earlier testing, like longer time spans for vibration testing, has meant the integration and testing process is just taking longer," said Eric Smith, program director for the James Webb Space Telescope at NASA Headquarters in Washington. "Considering the investment NASA has made, and the good performance to date, we want to proceed very systemmatically through these tests to be ready for a Spring 2019 launch."

The launch window request has been coordinated with ESA, which is providing the Ariane 5 launch of Webb as part of its scientific collaboration with NASA.

The James Webb Space Telescope is NASA's next great multi-purpose observatory and will be the world's most powerful space telescope ever built, serving thousands of astronomers worldwide. The 21-foot (6.5-meter) diameter infrared-optimized telescope is designed to study an extremely wide range of astrophysical phenomena: the first stars and galaxies that formed; the atmospheres of nearby planets outside our solar system, known as exoplanets; and objects within our own solar system. Webb is an international project led by NASA with its partners ESA and the Canadian Space Agency.

> NASA http://www.nasa.gov

FIRST STEPS: Returning Humanity To The Moon

In the first act of lunar exploration, Neil Armstrong and Buzz Aldrin were major characters. In setting its sights on the Moon, ESA hopes to bring many more actors to this off-world stage.

By testing the market for transport services to the Moon, ESA aims to push the limits of technology and create new models of space business.

Touching down on the Moon was a monumental moment in human history. Eight short years and enormous resources took humankind to the lunar surface, initially for less than one day. Those small steps for humanity, and the missions that followed, taught us much about the Moon, our cosmic time capsule. But humans have not returned since Apollo 17 departed in 1972.

Today's technology could easily get us back to the Moon, but it is still expensive to develop the ride and take everything needed to support life with us. ESA wants our return to the Moon to be sustainable and based on partnerships – not only with international space agencies but also with business. A commercial approach may just be the ticket – literally and figuratively – to making it happen.

Rather than develop a complete lander mission from scratch – a long and costly process – ESA wants to buy a ride on a commercial lander to deliver our precious research equipment safely to the surface. Once there, we are ready to pay the 'roaming charges' to talk to our hardware.

But for our return to the Moon to be truly sustainable, we must make use of lunar resources. So in addition to transportation and communication, we are looking to invest in the development and pay for the use of technology that can turn indigenous lunar material into oxygen and water, critical resources for sustaining future human operations in deep space.

Why the emphasis on sustainability? If been there, done that were the sole definition of exploration, then setting our sights only on more remote parts of our Solar System would make sense. But while we learned a lot about the Moon from Apollo, we literally just scratched the surface of Earth's eighth continent.

Satellites orbiting the Moon have since revealed the presence of oxygen and water ice. These are potential usable resources for our spacefaring future.

Shape the next act

ESA is inviting service providers with the right ideas to take part in a one-year study that will shape this In-Situ Resource Utilisation Demonstrator Mission. We want to hear what commercial partners need from us and share what we expect from them.

Together, we want to explore what it would mean to make lunar exploration a viable, competitive, and, most importantly, sustainable endeavour.

We want to go back to the Moon to crack its mysteries and use it as a springboard towards humanity's future in deep space. If you are a commercial enterprise ready to take on the challenge and build on the legacy of Neil and Buzz, then we want to hear from you.

Find more information visit the ESA Web Site below.

European Space Agency http://www.esa.int

ASTRO MOM: My Mom is an Astronaut By Rob Wood

"NASA to recruit Space Shuttle astronauts", was the rather mundane heading to the 8 July 1976 NASA press release announcing that they were accepting applications for a new astronaut class. But this was the beginning of a new era for NASA's astronaut corps. This would be the first group specifically selected to fly the Space Shuttle and also the first time that women would be accepted. On 16 January 1978, NASA announced the names of 35 astronaut candidates including six females. One of these was Anna Fisher.

She was one of a new type of astronaut. As a mission specialist astronaut she would not pilot the shuttle. Her job was as an engineer or scientist. The mission specialists were to acquire detailed knowledge of the shuttle's onboard systems, and look after, evaluate and operate the experiments and cargo. Their jobs were described as including deploying and retrieving satellites, servicing satellites in orbit, operating laboratories for astronomy, Earth sciences, space processing and manufacturing, and developing and servicing a permanent space station. At the time the shuttle was looked at as a replacement for virtually all of America's space launch needs.

Anna Lee Fisher was born on 24 August 1949 in St Albans, New York. She describes herself as an Army brat who was always on the move due to her father's military service (postings would each last for at best two or three years). Overall, she attended 13 different schools. As she was growing up she found her academic interests led her to mathematics and science. She remembers Alan Shepard's first manned American spaceflight in May 1961 as the point she first thought she would like to do something like that.

Despite the fact that all the astronauts at that time were pilots she did not consider a career in that area. As she got older she began to focus on a medical career. She was doing volunteer work at Harbor General Hospital in Torrance, California, when she told a friend "I'd really like to be an astronaut." Not that it seemed likely at that time and she continued to work her way to a medical career.

She obtained a Bachelor of Science in Chemistry from the University of California, Los Angeles (UCLA)' in 1971 and then spent a year working in the field of x-ray crystallographic studies of metallacarboranes. In 1972 she entered medical school at UCLA, obtaining a Doctor of Medicine in1976. She undertook a one year internship at Harbor General Hospital. It was during this period that a good friend told her fiancé about NASA's call for astronauts reminding him how he and Anna were always talking of their interest.

NASA's end date for applications was 30 June 1977 and that was only three weeks away. In those days, job applications were paper based. The Internet was in its infancy, so she had to put her application together by hand and with juggling her internship that was not easy. She later said that it was probably on the penultimate day of the application period that she got hers in. This was still better than her fiancé who got his postmarked on the day of the deadline.

Plans to take up a surgical residence were put on hold whilst she awaited news on her astronaut application. She decided to spend a year practicing Emergency Room medicine and also decided to get married. As she told NASA's Oral History Project, "I'm not one of these plan a wedding a year in advance kind of person." Then, just to complicate matters, NASA phoned to invite her to interview. "It's NASA," she said to her fiancé. "They want me to come interview." He replied, "Say yes, we'll figure it out." It was, a rollercoaster period for her. She married William Fisher on 23 August 1977 and reported to NASA on 29 August 1977 for the week long medical and interview process.

NASA announced the selection of the new astronauts on 16 January 1978 (NASA Group 8). She was successful but her husband was not (he was actually selected in the next group in 1980). She was one of six female astronaut candidates. They were the first females selected by NASA for their astronaut corps. As well as Anna Fisher there was Shannon Lucid a biochemist, Judith Resnik an electrical engineer, Sally Ride a physicist, Rhea Seddon a medical doctor and Kathryn Sullivan an Earth scientist.

The new astronaut candidates reported to the Johnson Space Center in July 1978 for what was originally due to be two years of basic training but this was changed to one. On successful completion of her training Fisher conducted a variety of tasks for the Astronaut Office including development and testing of payload bay door contingency spacewalk procedures and crew representative to support development and testing of the Canadian built Remote Manipulator System (RMS - known as Canadarm for obvious reasons). Her Canadarm experience would later come in handy.

For the Orbital Flight Test Program, STS-1 (flew 1981), STS-2 (1981), STS-3 (1982) and STS-4 (1982), she was on a rescue helicopter for launch and landing (at either prime or backup sites) ready to render medical assistance if required. As part of the Shuttle Avionics Integration Laboratory at Johnson, she supported the missions of STS-2, STS-3 and STS-4 working on ascent and re-entry procedures, RMS issues and software verification. Based out of the Kennedy Space Center, she was a crew representative to support vehicle integrated testing and payload testing for STS-5 (1982), STS-6 (1983) and STS-7 (1983).

In between the STS-3 and STS-4 missions, NASA announced the first female astronaut assignment to a crew. On 19 April 1982, Sally Ride was named to STS-7. Ride became the first female US astronaut when STS-7 launched on 18 June 1983. Judith Resnik (STS-41D in 1984) and Kathryn Sullivan (STS-41G in 1984) would be the next two before it was Fisher's turn. Ride made her second spaceflight accompanying Sullivan. But there was more to life than being an astronaut.

There was a decision to be made in Fisher's personal life. As she explained to a NASA interviewer years later, "I started to feel like when I was around 33, having been a doctor and studying all these charts about how your ability to conceive really dies off, and not knowing when I was going to be assigned to a flight. Bill and I decided we need to make a commitment to having a family if we want to do that and let the chips fall as they may in terms of flight assignments. I wound up getting pregnant."

She became a mother on 29 July 1983 when her first daughter, Kristin Anne, was born. She worked right up to the time of birth, almost literally, "I remember I was at work all day Thursday. I started to suspect I was going to go into labour that night. Sure enough that's the night Kristin decides to come. I had worked all day that day. Went in and had a pretty pretty long labour." Delivery was about 09:30 Friday morning. Her maternity leave lasted the weekend (actually, she did not take any formal leave). "Monday, I was just feeling so happy and so good. I was assigned to a flight. I had my new baby. I decided to go into the Monday morning [astronaut] meeting with my little doughnut to sit on the chair."

On 21 September 1983, NASA publically announced her placement on the crew of STS-41G, a satellite deployment mission, then due to fly in August 1984 but she was actually aware of this before she gave birth as NASA had told her of the assignment two weeks before Kristen was born. She was also assigned as one of the CapComs for STS-9 (flight took place over 28 November – 8 December 1983). She was juggling training for CapCom duties, training for her own spaceflight and motherhood.

Of this period she said, "If I didn't have training I didn't come in. If I had training I came in. Probably about two months like that, and then training picked up and went to full-time." There are certain aspects of motherhood that the Astronaut Office was not used to at the time, "Now everything's nice and they acknowledge that you might need to pump breasts, because I was breastfeeding. But I was just sneaking off by myself doing everything. It was kind of weird. It's so much nicer now that people are so supportive. Most restrooms you go into now, at least on the site, there's a partitioned area where you can do things like that. That was a bit of a struggle."

Kristen would grow up to become quite famous in her own right. Following a Bachelor of Arts degree in Broadcast Journalism she moved into that industry. In 2010, she won an Emmy for her bi-weekly segments on heroes in the greater Washington community. She currently serves as a Washington D.C.-based correspondent for Fox News Channel having joined the network in 2015.

In the same press release as the crew announcement for STS-41G, NASA explained changes in how Space Shuttle flights were designated. The change was initiated due to scheduling difficulties. STS-10 had been cancelled and other STS launches would be out of numerical order. However, NASA did not really explain how the change would help with the number ordering or scheduling problems.

The first number referred to the US Government's financial year that the flight was planned for, the second number told us the launch site (1 for the Kennedy Space Center and 2 for Vandenberg Air Force Base – Vandenberg was never used in the wake of the Challenger disaster) and the letter referred to the sequence within the financial year that the mission was scheduled to occur, i.e. A is the first flight and B the second flight etc.

Surprising no one, the change in numbering did not help with the launch order and the system was abandoned after Challenger. Rumours persist however that the new numbering system had little to do with scheduling issues but had more to do with superstition. Astronaut Mike Mullane later wrote that, "Astronauts and engineers aren't immune from it any more than the rest of the population." Apparently there was concern about having an STS-13 (hello, remember Apollo 13 anyone).

On 17 November 1983, following more scheduling difficulties, NASA announced that Fisher was now assigned to STS-41H. No date of launch was given but it was probably in the September to October 1984 timeframe. On 3 August 1984, a NASA news release showed she was now assigned to STS-51A as continuing technical problems caused chaos with flight plans. Launch was now set for 2 November 1984.

What Fisher would be doing on the flight was also evolving. When she was first assigned it looked like a fairly mundane satellite deployment mission. Although, as any astronaut will tell you, there is nothing mundane about spaceflight, to the general public, mundane was exactly what it looked like. STS-41B in February 1984 changed all that. The Westar 6 and Palapa B2 satellites had successfully deployed from

the payload bay but the McDonnell Douglas Payload Assist Module D (PAM-D) rocket engine upper stage boosters failed to put the satellites into the planned geostationary orbit.

Strategies were quickly formulated to rescue the satellites and by March 1984 Fisher and the rest of the shuttle crew were already working the problem. Despite this it was not until early September 1984 that NASA publically acknowledged that the now STS-51A crew would attempt to capture the errant satellites.

The Discovery Space Shuttle, as STS-51A, lifted-off from the Kennedy Space Center on 8 November 1984. Fisher was MS-2 and main RMS operator. Part of the role of MS-2 was as the launch and re-entry flight engineer assisting the commander and pilot. On entry into space she became the first mother to do so. Valentina Tereshkova and Svetlana Savitskaya who flew before Fisher had children but only after their spaceflights.

On the second and third days of the mission two communication satellites were deployed. The first, Anik D2, was put into geostationary orbit by a now functioning PAM-D. The second, Syncom IV-1, had its own built in upper stage and this took it to its geostationary orbit position. Fisher was the lead astronaut for one of the deployments.

The shuttle was then manoeuvred to a rendezvous with Palapa B2 and on 12 November 1984 an EVA team of Dale Gardner and Joe Allen conducted a spacewalk to capture the satellite. Fisher then grappled the satellite with the Canadarm and lowered it into the shuttle's payload bay. The satellite would not fit as planned into its prepared frame in the payload bay and the astronauts had to improvise a solution. Actually, it was a back-up plan that had been discussed before the mission. Experience had told the astronauts that this was a potential problem area. Eventually they were able secure the satellite. Two days later, it was the turn of the Westar 6 satellite. This time it was an easier capture as the astronauts used the experience and methods learnt on the first EVA. Fisher was again on the Canadarm.

As well as her duties with the Canadarm, she also assisted shuttle commander Rick Hauck during the rendezvous manoeuvres to both satellites. She was sat in the pilot's seat during the rendezvous because the mission pilot, Dave Walker, was helping the EVA team prepare for the spacewalks. She was working exhaustive twelve hour shifts. All the crew were very tired by the end of the EVA's.

Before Gardner returned to the airlock at the end of EVA operations he held up a hand drawn 'For Sale' sign and indeed that is basically what happened. Both satellites were now owned by insurance companies and were refurbished and resold. Westar 6, now under the name of AsiaSat 1, was re-launched on 7 April 1990 by a Chinese Long March 3 rocket. A few days later, on 13 April 1990, Palapa B2 followed. It had been sold back to the original owners and had a slight change of name to Palapa B2R. It was launched by a US Delta 6925-8 rocket.

Whilst carrying out the rendezvous manoeuvres they flew over where the Fisher family lived. The family could see the shuttle and satellite from the ground like two stars passing in the night sky. Her mother was excited and screaming. Fisher's own daughter, Kristen, says she remembers the excitement of the evening if not actually seeing the specks in the sky. Kristen recalls this as her first real memory. Years later, when she was in middle school, her class was given the project of writing about their first memory and she told the story. Her teacher said, "Well, that's really nice, Kristin, but you're supposed to tell a true memory."The teacher was not aware of who her mother was but her friends in class were and all chorused, "But it is true."

On 16 November 1984, Discovery returned to Earth at the Kennedy Space Center. Fisher would not have a long wait for her next flight assignment. About two weeks after landing, NASA told her she had been selected for a second mission. NASA publically announced her appointment to the crew of STS-61C on 29 January 1985, then scheduled to launch in December of that year. It was not long before payload problems led to a reassignment to STS-61H. That was announced on 25 March 1985, looking towards a June 1986 launch.

Her husband's turn in space came with STS-51I (27 August – 3 September 1985). The main payload was the deployment of three communication satellites and the capture and repair of another communication satellite. Four more shuttle missions followed through to January 1986. A year that was due to be very busy, but in the end saw only one successful shuttle flight.

On 28 January 1986, Anna Fisher was at the Johnson Space Center on a robotics training session in the Shuttle Mission Simulator. STS-51L, the second shuttle launch of 1986, was ready for lift-off from Launch Complex 39-B. The simulation was stopped so they could watch the launch. "Lift-off of the 25th Space Shuttle mission and it has cleared the tower," said the NASA public affairs officer. Rather bland opening words considering what was to follow. Just over a minute later the Space Shuttle Challenger exploded. It was T+73 seconds. Fisher turned to her astronaut colleague for STS-61H, James Buchli, and said, "We're going to cancel."

The crew of seven on Challenger all died. America's space programme was in tatters. A year that had a planned flight rate of more than one a month ended at two. The cause of the disaster was the failure of the O-ring on the bottom joint on the right side Solid Rocket Booster to seal correctly as a consequence of cold weather. This allowed burning gases to reach the outside impacting on the rest of the launch stack causing it to break up. During the post-flight investigations it was revealed that there had been problems with the O-rings on fourteen of the twenty-four previous Space Shuttle launches.

Within a couple of weeks of the accident all assigned crews were stood down. The future looked uncertain and there was certainly going to be a long delay before the next shuttle flight. By October 1986 it was known that the next shuttle launch would not be before 1988 (it was actually September of that year).

For Fisher, it was a return to technical duties for the Astronaut Office. Although not officially a flight crew, the astronauts formerly assigned to STS-61H, including Fisher, conducted a number of ground based simulation tests in 1986 and 1987. She served on the Astronaut Selection Board for the 1987 class of astronauts. She was also part of the Space Station Support Office. In addition, 1987 saw her receive a Master of Science degree in Chemistry from UCLA.

Next up was a return to motherhood. From 1989 to 1995, she was on a leave of absence from NASA to raise her family. This included a second daughter, Kara Lynne, born on 10 January 1989. Sadly, her marriage to William did not stand the test of time and they divorced in 2000.

She returned to the Astronaut Office in January 1996 working on shuttle and ISS issues. From June 1997 to June 1998, she was Chief of the Operations Planning Branch and then Deputy Chief for Operations and Training for a year before taking up the post as Chief of the Space Station Branch. Whilst Chief of the Space Station Branch, she coordinated inputs to the operations of the space station, working closely with all the international partners and supervising assigned astronauts and engineers. She played an important role in building the foundations for the ISS Programme. She found a novel way of motivating new astronauts in her charge. She told them, "If this thing doesn't work, have you all looked at the manifest? It's all Space Station build. If this doesn't work you guys are out of a job. I suggest you do whatever it takes to get this thing to fly."

Following her time as Chief of the Space Station Branch she worked on flight data and training within the shuttle programme. She was also assigned to the Exploration Branch of the Astronaut Office. From January 2011 through August 2013, she was an ISS CapCom working in the Mission Control Center. She was the lead CapCom for ISS Expedition 33. Towards the end of her time with NASA, she worked on display development for the Orion Multi-Purpose Crew Vehicle as part of the Exploration Branch.

When she returned to the astronaut corps in 1996 after her leave of absence there was an expectation she would fly again but in the end that did not happen. I can find no open source to explain this. There is speculation but nothing that reasonably explains why. She was certainly listed as an active astronaut following her return but it is not clear when she stood down. The statistical website Spacefacts lists June 2006 as when she left active status, although other sources say she was still active in 2010. Her NASA biography could be interpreted as her moving to management status at any time in 2013/2014. It is dated July 2014, noting her management status, which could have occurred after her CapCom stint.

On 28 April 2017, NASA announced that Anna Fisher had retired from the agency to spend more time with her family. "We appreciate all of the years that Anna has dedicated to our space program," said Chris Cassidy, Chief of NASA's Astronaut Office at the Johnson Space Center. "She has provided insight to many incoming astronauts as well as new programmes. Anna, and that first class of astronauts to include women, set the stage for decades of female astronauts after them and provide a tremendous inspiration to young girls."

All six of NASA's original female astronauts flew in space. Judith Resnik died in the Challenger tragedy on what would have been her second spaceflight. Sally Ride retired after Challenger having made two spaceflights. She died in 2012 as a result of pancreatic cancer. All six had flown at least one mission before Challenger was destroyed and three would fly further missions after Challenger. Rhea Seddon and Kathryn Sullivan each completed three spaceflights in total. Sullivan made the first US female spacewalk in 1984. Shannon Lucid flew five times overall including a residential mission to the Russian Mir space station in 1996, which turned out to be the last spaceflight of the original six.

Acknowledgements and sources:

Americaspace.com; Astronaut.ru; CapCom (previous issues); Collect Space; Google; NASA and its various centres; NASASpaceflight.com; Praxis Manned Spaceflight Log 1961-2006 ©2007 by Tim Furniss and David J Shayler with Michael D Shayler; Riding Rockets ©2006 by Mike Mullane; The Shuttlenauts 1981-1992: The First 50 Missions. Volumes 2: Space Shuttle Developing an Icon 1972-2013 ©2016 by Dennis R Jenkins; Space.skyrocket.de; STS Flight Crew Assignments ©1992/1993 by D J Shayler Astro Info Service Publications; The Shuttlenauts 1981-1992: The First 50 Missions. Volume 3: Flown Crew Biographies ©1996 by D J Shayler Astro Info Service Publications; Spacefacts; Who's Who in Space ©1999 by Michael Cassutt; Wikipedia; Women in Space ©2005 by David J Shayler and Ian Moule; Jill Wood.

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COMMENTS & UPCOMING IN THE NEXT ISSUE OF ASTRONAUT NEWS

Another astronaut retirement as Bill McArthur leaves NASA.

Acknowledgements and sources:

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Satellites Track Powerful Hurricane Maria From Space

A number of satellites are keeping tabs on Hurricane Maria as the dangerous storm churns its way through the Caribbean.

Imagery captured recently by the GOES East satellite, for example, shows Maria strengthening to a Category 5 hurricane — the most powerful type — and slamming into the island of Dominica on 18 September.

The storm's impending arrival has forced the huge Arecibo Observatory, a 1,000-foot-wide radio dish in Puerto Rico, ceased operations up until Thursday 21 September.

The Global Precipitation Measurement (GPM) satellite — a joint effort of the Japan Aerospace Exploration Agency and NASA — got a dramatic look at Maria's turbulent interior yesterday. GPM's observations revealed a thunderstorm cell inside Maria that reached up into the stratosphere.

"Enough water vapour was condensing into rain inside of this cell that rapid updrafts developed, rapid enough to lift the precipitation until it froze and then even higher until it penetrated into the lower stratosphere at 16.75 kilometres [10.4 miles] altitude," Owen Kelley, of NASA Goddard's Precipitation Processing System, said in a statement.



Hurricane Maria moves across the Caribbean Sea as a Category 5 storm

Image: NASA/NOAA GOES https://goes.gsfc.nasa.gov/

Full story at Space.com

The first crewed test flight of Boeing's CST-100 Starliner commercial crew vehicle could slip into early 2019

The company said at the International Astronautical Congress (IAC) that it is in the "thick of testing" the vehicle and making good progress, with an uncrewed test flight planned for the third quarter of 2018. That will be followed by a flight with crew as soon as the fourth quarter, although the company said that might instead take place early in 2019. Boeing will work with NASA to select the crew for that test flight about a year before launch.

Cubesat's on Electron

Rocket Lab will fly cubesats from two companies on the second test flight of its Electron vehicle. Rocket Lab said this week that the Electron, which initially was not going to carry any payload, will instead carry two cubesats each from Planet and Spire. Rocket Lab plans to transport the rocket to its New Zealand launch site in October, although company CEO Peter Beck said at IAC that it may be eight weeks before the rocket is rolled out to the pad for a launch.

> Both stories from Spacenews.com http://www.spacenews.com



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Contributions to CapCom

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Copy Deadline

All contributions intended for the November - December 2017 issue should be emailed to the editor by

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