

AERO SPACE

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May 2017

**HUMANITARIAN
AEROSPACE**

**ON THE RECORD
WITH GULFSTREAM
PRESIDENT**

**GENERAL AVIATION
DESIGN COMPETITION**

May 2017

Volume 44 Number 5

Royal Aeronautical Society

MERCURY RISING

ESA'S BEPICOLOMBO PROBE GETS SET TO
EXPLORE



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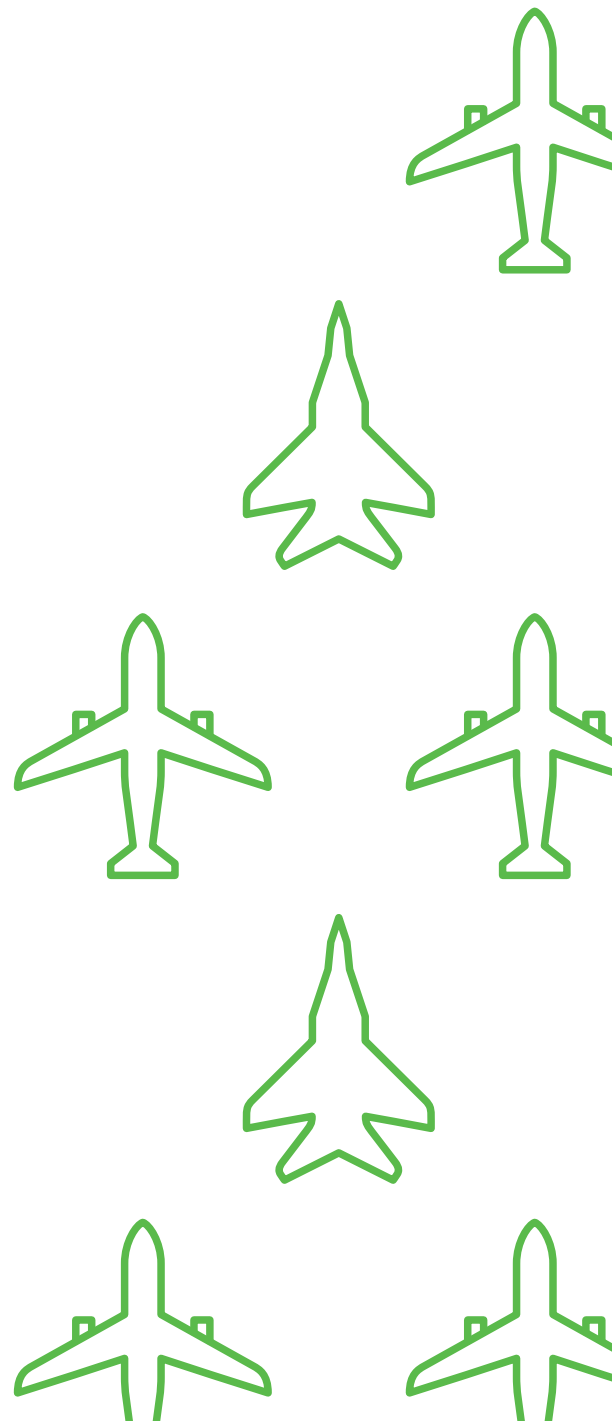
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Correspondence on all aerospace matters is welcome at: The Editor, *AEROSPACE*, No.4 Hamilton Place, London W1J 7BQ, UK publications@aerosociety.com

Comment

Business aviation - taking the rap?

Play word association with 'bizjets' and what immediately comes to mind? Champagne? Superyachts? Superstar rappers and supermodels? Exotic locations and overpaid CEOs, perhaps? Partly this image is created by the industry itself – glamour and exclusivity help sell the product, whether it is new aircraft, or cabin interior specialist, business aviation airport or charter operator. Yet in promoting this image, the business aviation sector also perhaps does a disservice to the many ways it provides 'social' good, either through creating high-skilled jobs, boosting regional and smaller airports and stimulating economic growth by allowing executives to increase their productivity by using time better. Medical evacuation and emergency flights, transportation of parts and mail, humanitarian missions by NGOs, mapping and surveying and other missions too may fall under the category of business aviation that are rarely discussed. Interestingly, but predictably, there is a noticeable division on both sides of the Atlantic of the image of business aviation. In the US, a keen advocate of business aviation, who recently upgraded from a 757 to the ultimate VIP aircraft, Air Force One, perhaps personifies the hallmark of the American attitude to wealth and status symbols. Meanwhile, in the UK and Europe, it is a more difficult sell. A history of more socialist governments and a negative public reaction to ostentatious riches, means that private jets are often automatically labelled as luxuries. As we head into EBACE this month, it is worthwhile considering, as a RAeS event did in April, whether it is time to rethink business aviation – to better understand and communicate the real opportunities and economic benefits it can bring. Between the extremes of a brash US 'if you've got it, flaunt it' attitude and a European shyness about defending private jets – there surely must be a happy medium.

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Unless specifically attributed, no material in *AEROSPACE* shall be taken to represent the opinion of the RAeS. Reproduction of material used in this publication is not permitted without the written consent of the Editor-in-Chief.

Printed by Buxton Press Limited,
Palace Road, Buxton, Derbyshire
SK17 6AE, UK

Distributed by Royal Mail

AEROSPACE subscription rates:
Non-members, £160

Please send your order to:
Dovetail Services Ltd, 800 Guillat Avenue, Kent Science Park, Sittingbourne, Kent ME9 8GU, UK.
+44 (0)1795 592939
+44 (0)844 856 0650 (fax)
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Any member not requiring a print version of this magazine, please contact: membership@aerosociety.com

USA: Periodical postage paid at Champlain New York and additional offices.

Postmaster: Send address changes to IMS of New York, PO Box 1518, Champlain NY 12919-1518, USA.

ISSN 2052-451X

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Radome

INTELLIGENCE / ANALYSIS / COMMENT

Haas 2C specifications

Length: 53ft

Diameter: 5ft

Weight (empty): 1,210lb

Weight (fuelled): 35,887lb

Thrust (sea level): 50,500lbf

Thrust (vacuum): 74,000lbf

Payload to LEO: 100kg

Linear aerospike engine

The Haas 2C will use the Executor linear aerospike engine to fly the entire rocket into orbit in less than 5mins. Aerospike engines are not a new idea but, unlike the traditional bell rocket nozzle which loses aerodynamic efficiencies at certain phases of flight, the aerospike uses the outside air pressure to create the nozzle – maintaining its efficiency all the way to orbit and saving up to 30% fuel at lower altitudes. The Executor linear aerospike will deliver 50,500lbf of thrust at sea level and is powered by hydrogen peroxide and kerosene.



Launch from anywhere

Using a single stage to orbit (SSTO) launcher not only reduces cost and complexity compared to staged rockets says ARCA, but also opens up new possibilities of inland launch sites, without having to worry about spent stages dropping back to Earth. It would also allow for the entire rocket to be refuelled in orbit for missions beyond LEO.

\$1m per launch

ARCA claims that an aerospike-powered SSTO could become the cheapest ever small satellite launcher at \$1m per launch for a 100kg payload into LEO or \$10,000/kg. The company says that the Haas 2C would provide a flexible 24hr rapid response launch capability.

SPACEFLIGHT

Aerospike direct to orbit

Revealed by New Mexico-based space company, ARCA, on 28 March was the Haas 2C- a linear aerospike powered launcher concept that could say the firm, provide a revolutionary single-stage to orbit (SSTO) capability – which promises simpler, cheaper and more reliable launches for small payloads. Originally formed in Romania, ARCA relocated to the US in 2013 and has competed in the Ansari X-Prize as well as investigated stratospheric balloon-launched rocket concept. For the Haas 2C, ARCA is aiming to launch the first test flight in 2018 from NASA's Wallops Flight Facility in Virginia and is now working to get FAA approval.

Radome

GENERAL AVIATION

Bristow carries out UAV interoperability test

Bristow Group and its UAV partner Sky-Futures have carried out a first in civil manned/unmanned interoperability, with a flight trial involving a helicopter and UAV flying together. The 20 minute trial, carried out in Galliano, Louisiana, saw a Sikorsky S-92 hover 500ft above the ground and

the crew maintain track on a UAV 200ft away using an iPad app – even when they were unable to keep visual contact on the UAV itself. The company called the trial: "A critical first step in ... a process proving that UAS and manned helicopters can operate safely in the same airspace."

DEFENCE

US strikes Syrian airbase after sarin gas attack



On 7 April, the US launched 59 Tomahawk cruise missiles from two warships in the Mediterranean at the Syrian airbase of Shayrat. The strike was in response to SyAAF aircraft from the airbase being identified as responsible for a suspected sarin gas airstrike on the town of Khan Sheikhoun that killed more than 80 people, including children on 4 April. The US Pentagon said that the strike was a 'proportional response' and that it had removed the means of delivery of chemical weapons.

US DoD

AEROSPACE

London-Paris hybrid electric flights in a decade, says start-up



A new US start-up, Wright Electric, has revealed plans for an electric 150-seat narrowbody airliner that, it says, could perform short-haul flights within the next ten years. The aircraft, called 'Wright One' would use modular swappable battery packs and be either fully electric or hybrid electric, depending on the advances in power storage. The company, founded a year ago, is working with ESAero which has already studied an ECO-150R airliner concept for NASA. UK low-cost carrier easyJet has also expressed an interest in the concept. Wright Electric's aim is to make all short-haul flights electric within 20 years.

Wright Electric

AIR TRANSPORT

Electronics ban causes anger and confusion

Due to elevated security concerns, the US has banned passengers on US-bound flights originating from airports in ten Middle East and North African countries from carrying electronic devices larger than a mobile phone, such as laptops and iPads, as hand luggage in the aircraft cabin. The ban affects flights from airports in Egypt, Jordan, Kuwait, Morocco, Qatar, Saudi Arabia, Turkey and the UAE.

The UK followed suit with a similar ban from inbound flights from Turkey, Jordan, Lebanon, Egypt, Tunisia and Saudi Arabia.

The decision drew criticism from industry experts – including the D-G of IATA, Alexandre de Juniac, saying the ban was "not an acceptable long-term solution." Others noted that the ban reverses recent safety advice over carrying lithium-ion batteries.

NEWS IN BRIEF

Embraer's new E195-E2 re-engined regional jet made its first flight on 29 March, three months ahead of its original schedule. The test aircraft made a two-hour flight from Embraer's São José dos Campos base in Brazil to evaluate aircraft performance, flight quality and systems. The E195-E2 is scheduled to enter service in the first half of 2019 with Azul Brazilian Airlines.

Iran's third largest airline, Aseman Airlines, has signed a memorandum of agreement to purchase up to 60 (30 firm, with options for an additional 30) Boeing 737 MAX airliners. The deal, worth \$3.4bn at list prices, remains subject to US Government approval.

According to the Japanese Ministry of Defence, Japan and the UK are to co-operate on studying

future manned fighter requirements – as well as a potential joint project. Earlier this year London and Tokyo signed an agreement strengthening defence ties – which includes work on an AESA seeker upgrade for the Meteor BVRAAM.

The European Space Agency (ESA) has shortlisted two alternative landing sites for its 2020 ExoMars rover and surface science platform, at either

Oxia Planum or Mawrth Vallis, both just north of the equator. A final decision on which landing site will be selected will be made in 2019.

Five members of the same family were killed when their AS355 Twin Squirrel helicopter crashed in Snowdonia, Wales on 29 March. The family were flying from Milton Keynes to Dublin for a confirmation. An investigation has begun into the cause of the crash.

Airbus has abandoned plans to produce a two-seat scaled-up version of its E-Fan 2.0 electric light aircraft for the GA training market. Instead it says it will focus on a larger design, E-Fan X, to take advantage of improvements in battery and power technology.

Virgin Atlantic has launched a new service from London, UK, to Seattle, Washington, using

AIR TRANSPORT

No flights after Brexit, Ryanair warns

On the day the UK triggered Article 50 to leave the EU, low-cost carrier Ryanair has warned that there could be no flights to and from Britain to Europe straight after Brexit. The budget carrier argues that unless a bilateral aviation agreement is found with

the EU, there might be no flights for a period after March 2019. It points out that the UK Government needs to quickly prioritise an aviation agreement, as it, and other airlines, will finalise summer schedules for 2019 by March 2018 and: "put aviation at the top of its agenda."

AEROSPACE

Hat-trick of first flights

March 31 saw three first flights on the same day from three manufacturers. Airbus flew its A319neo from Hamburg, Antonov flew the joint Saudi/Ukrainian An-132D from Kiev, while Boeing's 787-10 Dreamliner took to the skies from North Charleston, SC.



Airbus



Antonov



Boeing

SPACEFLIGHT

Reuse, recycle – SpaceX flies used rocket to launch sat

On 30 March, SpaceX made history when it successfully delivered an SES satellite into orbit using a previously flown Falcon 9 first stage booster. The Falcon 9 has been refurbished since it flew a Dragon capsule to the ISS in April 2016. As well as the first stage returning to Earth by vertically landing on its drone ship, in another first, the company also recovered the nose-cone fairings which soft-landed using parachutes. Musk tweeted on this reusable launcher breakthrough: "Incredibly proud of the SpaceX team for achieving this milestone in space! Next goal is reflight within 24 hours."



SpaceX

DEFENCE

Gripen goes green with biofuel

Saab has announced it has flown its Gripen on a 100% biofuel test – the first flight on a single-engine fighter using this alternative fuel. The trial, carried out using a two-seat Gripen D from the company's facilities in Linköping, Sweden, saw

a series of test flights flown with the alternative biofuel, CHCJ-5, which is made from rapeseed oil. Saab said of the flight trials: "The test team noted no differences between the biofuel and the ordinary jet fuel."



Saab

Boeing 787-9 Dreamliners. The new daily flights, which replaces its partner Delta on this route, comes as Alaskan Airlines took the decision to retire Sir Richard Branson's Virgin America brand, which Alaska had acquired in 2016. The name will be phased out in 2019.

The Sikorsky CH-53K heavy-lift helicopter has been approved for full production by the US Pentagon. The US Marine

Corps are set to receive 200 King Stallions, which will replace aging CH-53Es in service.

On 10 April two Russian cosmonauts and a US astronaut in a Soyuz capsule safely touched down by parachute in Kazakhstan, ending a 173-day mission on the ISS. Command of the station has now passed to US astronaut Peggy Whitson who, as AEROSPACE goes to

press, is set to break the US record of 534 days for the most time spent in space.

Cessna has begun assembly-line production of its new Citation Longitude business jet in Wichita. The manufacturer now has three out of an eventual five flight test aircraft operating and Cessna hopes to certificate the aircraft and start deliveries by the end of 2017.

UK CAA-commissioned research has found that aircrew's poor English may be increasing the risk of serious aviation accidents. The study not only highlighted potential misunderstandings caused by non-native English speakers who may have gained their ICAO proficiency fraudulently, but also by native British pilots and controllers due to slang and speaking too quickly.

British Airways is to boost its Club World (long-haul business) class with £400m of investment, as well as for the short-haul Club Europe.

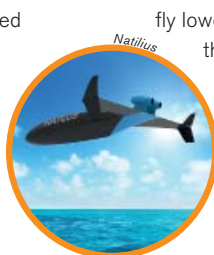
Czech manufacturer Aero Vodochody has unveiled its first modernised L-159 ALCA light attack jet and re-opened the production line after a 15-year gap. It recently handed over a two-seat version to the Iraqi Air Force.

Radome

AEROSPACE

Natilus plots 777-sized freight seaplane UAVs

A California-based start-up has revealed plans for a new air cargo concept using 200ft-long seaplane UAVs to carry up to 200,000lb of freight. Natilus envisages that its cargo UAVs (which would be loaded and unloaded at ports) would



fly lower and slower than airliners but would be faster than ships – with the goal of halving the cost of air freight. The company is set to fly a smaller 30ft demonstrator this summer, between Los Angeles and Hawaii, to trial the concept.

Lockheed Martin

DEFENCE

ASRAAM missile fired from F-35 for first time



F-35s have conducted the first firings of the MBDA ASRAAM air-to-air missile – the first test of a non-US missile by the stealth fighter. The test firings took place in the US, using test F-35s operated from Edwards AFB and NAS Patuxent River. The firings mark a key milestone in the integration of ASRAAM with UK F-35Bs.

AIR TRANSPORT

IAG aims to Level up



BA and Iberia parent, IAG, is to launch a new low-cost carrier in June operating between Barcelona and the US and South America. Named Level, the new budget carrier will fly Airbus A330s crewed by Iberia pilots and cabin staff to and from Los Angeles, Oakland, Buenos Aires, and Punta Cana in the Dominican Republic.

LEVEL

SPACEFLIGHT

OneWeb breaks ground on new factory

Satellite Internet constellation company OneWeb Satellites (a joint venture between OneWeb and Airbus Defence and Space) has begun construction of a new \$85m high-volume satellite manufacturing factory in Exploration Park, Florida. The facility is expected to create nearly 250 jobs and

manufacture more than 648 150kg satellites as well as 250 spares. Earlier this year, at a RAeS lecture in London, OneWeb founder, Greg Wyler, said that the company was considering quadrupling the size of the low-Earth orbit Ku-band broadband constellation – with a further 1,972 satellites.

NEWS IN BRIEF

NASA has selected commercial launch provider United Launch Services to provide launch services for the National Oceanic and Atmospheric Administration (NOAA) Joint Polar Satellite System-2 (JPSS-2) mission scheduled for 2021.

Austria's Diamond Aircraft has revealed its first rotary-wing design – a four seat light helicopter called the

DART 280. The helicopter is aimed at the training market with a first flight scheduled for October 2018.

US start-up Boom Aerospace has announced it has raised a further \$33m in funding for its 45-seat supersonic airliner project. The funding boost now means it will be able to complete the first phase of its plan, which is to fly XB-1, a two-seat Mach 2.2 demonstrator, in 2018.

Airbus has revealed new cabin options for its flagship A380. The 'New Forward Stairs' ditches the curving 'Grand Staircase' and along with other space optimisation tweaks, allows 80 additional passengers to be carried.

Boeing has received a Lot 8 \$2.2bn contract for 17 P-8 Poseidon maritime patrol aircraft. The production batch also includes the first two

P-8As for the UK, with delivery in 2019.

As *AEROSPACE* goes to press, NASA is preparing to give instructions to its Cassini probe to dive between the rings and Saturn's atmosphere as part of its 'grand finale' after a 13-year mission. The probe is expected to make 22 ever closer passes to gain additional data before the atmosphere destroys it in September 2017.

A British inventor has put together a real-life 'Iron Man' style jetpack system using model jet engines. The Daedalus suit uses six micro jet turbines (four on the arms and two on the hips) to provide enough thrust to lift the wearer. The suit, which Richard Browning (founder of start-up Gravity), has flown a few metres off the ground so far, also incorporates a helmet-mounted head-up display.

AEROSPACE



Boeing has launched a new venture capital business unit, HorizonX aimed at investing in innovation and disruptive technology for aerospace.

It revealed the first two HorizonX investments – one in Upskill, a Washington DC-based company focused on augmented reality solutions for manufacturing and logistics. The second investment, in conjunction with JetBlue Technology Ventures, is in Zunum

Aero, a Kirkland, WA start-up developing hybrid electric aircraft concepts. Zunum has been secretly working on 10-50 seat hybrid-electric aircraft for the past three years, with the goal of lowering seat costs by 40-80%. Aimed at revolutionising the regional airliner market, to begin with Zunum plans to develop a ten-seat 700nm range version by the 2020s, with a larger 50-seat hybrid airliner with a 1,000nm range ready for the 2030s.

ON THE MOVE

Olivier Savin has been named as Safran Nacelles' VP – Customer Support & Services.

The head of Boeing's new HorizonX venture capital arm is Steve Nordlund, formerly VP Strategy at Boeing Defense and Space.

Former Austrian Airlines Group head Vagn Sorensen has been

named as the new chairman of Air Canada. He replaces David Richardson.

Rear Adm Mathias Winter has been nominated the next head of the Pentagon F-35 Joint Programme Office. He takes over from the USAF's Lt Gen Christopher Bogdan.

Brandon Mitchener is the new CE of the European Business Aviation Association (EBAA).

DEFENCE

India signs \$2bn air defence deal with IAI

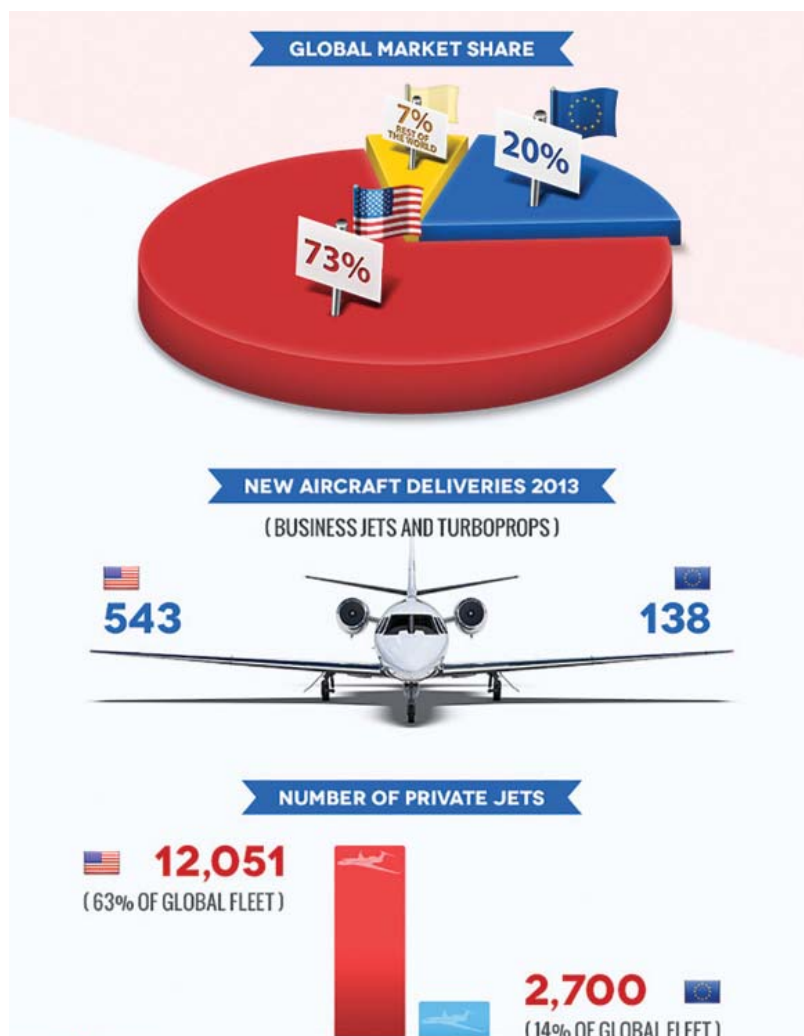
Israeli Aerospace Industries (IAI) has sealed what has been described as Israel's biggest-ever arms deal with India for advanced SAM systems. The near \$2bn deal comprises the 70km medium-range

MRSAM for the Indian Army, and the long-range LRSAM for the new Indian Navy carrier INS *Vikrant*. MRSAM and LRSAM, jointly developed by IAI and India's DRDO (Defence Research & Development Organisation) uses the Barak 8 missile.



GENERAL AVIATION

INFOGRAPHIC: European and US business aviation differences



Airlines: service or price?

Since they appeared on the scene in the early 1990s, the so-called 'Budget' airlines have established themselves right across Europe and North America and with far lower costs than the long established 'legacy' or 'flag-carrier' airlines and no historic 'baggage' to carry, they have tended to be more profitable as well.

Following the demise of Laker Airways and the gap that ensued, the subsequent extraordinary rise of 'budget' airlines through the 1990's and beyond was never going to be easy for 'legacy' airlines to halt. To compete and stem the loss of passengers seeking cheaper ticket prices at the expense of service, 'legacy' airlines such as British Airways and Lufthansa found themselves compelled to take extreme cost cutting measures and slashing the price of tickets if they were to have any chance of surviving the onslaught.

Legacy airlines almost inevitably carry cost burdens that budget airlines do not. For a start they often carry burdens of history meaning the networks that they operate rested rather heavily on a belief that passengers come to them because they offer a higher level of customer service that budget airlines do not. Not any longer it seems, and as time has gone by, to attempt to better match budget airline competition, legacy airlines are copying budget airlines in almost every respect to the extent of increasing the numbers of seats on aircraft by further cutting the amount of legroom, charging for drinks, food and other refreshments and even going as far as to reduce toilet facilities.

It seems that the old adage 'if you can't beat them, join them' is the order of the day for an increasing number of 'legacy' airlines these days. The strategy for some is one step short of turning themselves into would-be 'budget' airlines and reducing the quality of services offered to passengers to keep prices low. It is almost as if, rather than see their role as being a 'passenger operation', an increasing number of European-based legacy airlines see their goal as being about the moving of 'passenger freight'.

As descriptions go, this last may be a little harsh but to passengers travelling on European short-haul routes today, that is increasingly how it appears. If challenged on the issue of what they offer passengers, most 'legacy' airlines flying short-haul

routes would probably reply saying that as far as short-haul flights are concerned, customer feedback is that they buy tickets primarily based on price offered against that of competing airlines so they have little choice but to conform.

Race to the bottom?

But is it all going too far and are the standards of service that customers have a right to expect being lowered too much to keep airline ticket prices low?

In its quest to increase the number of seats on short-haul European routes, British Airways has recently announced its intention to further cut the amount of legroom between rows of seats in economy class by one-inch to 29 inches on all of its single-aisle aircraft fleet, which consists primarily of Airbus A320 family aircraft. By doing this the airline should be able to squeeze in at least another couple of rows of seats.

For a man of average height, further reducing legroom may just about be manageable albeit uncomfortable should the person in front choose to put his seat back. But for a person over six-foot tall it may be just about intolerable.

Of course, there are those that would argue that larger people have had it far too easy for years and that they should be required to pay more for tickets or to use business class. I do not jest and in researching for this piece one person even had the nerve to say that shorter people have been subsidising taller people such as myself for far too long!

Cutting the amount of leg room to squeeze more passengers on the aircraft isn't the only cost saving or revenue-enhancing change that British Airways has planned. Along with fellow IAG subsidiaries, Vueling and Iberia, British Airways has now done away with the 'free' trolley service for economy passengers on all European short-haul routes, replacing this with a chargeable service selling sandwiches produced by a leading High Street brand. This move has not proved popular with passengers though and, worse, because staff have to collect money from passengers choosing to use it, the overall trolley service offered to passengers takes rather longer than it did before.

Removal of toilet/washroom facilities on short-haul flights is yet another of the more recent





British Airways is balancing squeezing in more seats and axing complimentary meals in economy by boosting its Club World business class.

wheezes used by some airlines in order to further increase the number of seats and there are now an increasing number of complaints heard that, on a three-hour flight, having only one washroom facility available for 'cattle class' passengers is too few.

I understand, although I cannot confirm, that one legacy airline has even been doing a trial at London Gatwick whereby they no longer do a full clean of a aircraft each time it lands. Instead, they pay the crew a 'tenner' to do a swift clean of the aircraft. I am also told that lavatory tanks are no longer emptied until they are at least half full! One unnamed airline source told me that the trial is based on observing whether passengers notice any difference in how clean the aircraft actually is.

Legacy airlines such as British Airways will probably always like to claim to be offering a better standard of service to that offered by budget airlines but today I might be forced to observe that there is now very little difference between them except for one thing – the reality is that ticket prices offered by legacy airlines are still much higher than the equivalent offered by budget airlines. That is because it isn't so easy for legacy airlines to dump costly overheads and long-standing agreements. However, they can at least usually claim to be taking you to an airport that is not in the middle of nowhere.

Of course, we have been down this road before. For example, I remember when British Caledonian (BCAL) really did focus on customer service and they were probably a far better airline than given credit for. Sadly, BCAL was in effect forced to operate from Gatwick to protect the then state-subsidised British Airways. I have no idea what it would look like now if it had been allowed to survive as an independent, but I and others regret that BCAL was sacrificed by the Thatcher Government to allow British Airways to grow in financial strength under then Chairman Lord King to hasten the airline's privatisation. Arguably, British Airways back

then did not understand customer service or markets or for that matter airline economics in relation to mixed short and long-haul. If it had I doubt that it would have continued a mixed fleet operation.

'Value added'

I confess to having not met with British Airways CEO Alex Cruz who came into the IAG Group through its acquisition of Vueling. Cruz denies trying to turn British Airways into a budget or low cost airline and with overheads he has such as operating from Heathrow he would be foolish to do so. But, he does come from an airline and a country, Spain, where passengers using the airline are more than prepared to pay extra for services including seat assignment. The term to use is selling more 'value added' and if that is the way that British Airways chooses to go then so be it.

Airline customers are in my view more than prepared to pay extra for quality but only if what they are paying for gives them what they want. What they are not prepared to cope with is an airline claiming to be something that it was not through contriving to offer better levels of quality that do not exist and yet that make the airline appear to be more expensive and better than its peers.

British Airways has been down this road before and old hands will remember the short-lived attempt to run with a separate low-cost airline called GO. Lufthansa's low-cost subsidiary Eurowings is doing the same thing and other newcomers such as Norwegian Airlines are also joining the low-cost ticket price club.

IAG also has plans to start a fifth brand long-haul budget airline to be called 'Level' later this year flying between Los Angeles, Oakland, Buenos Aires and Punta Cana in the Dominican Republic and link to all IAG airline services – British Airways, Iberia, Aer Lingus and Vueling – that operate on the European network.



ARE THE STANDARDS OF SERVICE THAT CUSTOMERS HAVE A RIGHT TO EXPECT BEING LOWERED TOO MUCH TO KEEP AIRLINE TICKET PRICES LOW?

Transmission

LETTERS AND ONLINE



Dhaval Panchal [On Circular runways⁽¹⁾] This proposal makes the most sense for a fully autonomous distribution hub that uses fixed-wing distribution drones. Passenger aircraft and human pilots would, especially if mixed, make this a very difficult challenge. Fully automate the drones and air traffic control and it would work beautifully. I can see this being used by the likes of Amazon in the future.

Eur Ing Bishnujee Singh [On RAeS President Prof Chris Atkin CEng FRAeS being elected Chair of the Engineering Council] Congratulations Prof Atkin, we are delighted to hear about your election as Engineering Council Chairman. You have been a pro-active President of RAeS.

Anthoile Greenman Congratulations! Wishing you all the best in your new role as the chairman of the Engineering Council.



Richard Betts FRAeS, Chartered MCIPD [On Circular runways⁽¹⁾] I thought April Fools Day was a few days ago.



@ISR_manager [On Questions for the RAF to consider at the Air Power Conference in July⁽²⁾] How can a technical service keep its people at the heart of capability with all that that entails for EP funding and force management?

@mgarica_writer [On UK PM triggering Article 50] I heard no mention of Open Skies issues or unified aviation policy. Did I miss them?

@Jinker_de BIG thanks to @AeroSociety for organising our entry into the Kremer Prize Sports Record Attempt @RAeSTimR. Support igg. me/at/jinker

@Mark_Hartshorne At age 17 I played a ouiji board with 2 mates and we got 'talking' to a spirit of a man that used to work for @RollsRoyce in Derby! Eerie.

@TotherChris [On ARCA's SSTO aerospike rocket] This must be the third, possibly fourth, time we've been promised a working aerospike, linear or toroid.

@2385MelkshamSqn Excellent lecture evening at Defence Academy Shrivenham last night. Thanks RAeS!

Passenger laptop ban

@anikadmali [On US/UK passenger electronics ban⁽³⁾] Absolute rubbish.

@comiquaze Why ban certain carriers and not others? Screening is the same at some Middle-East points of departure? This is nuts.

@errolwi Both unsurprising and a very incomplete indication of usage of banned devices in flight. Download a video or work before flight.

@StTim Is that a stable door left open?

Qatar Airways



Would the lithium batteries used to power electronic devices pose more of a danger in the hold of an aircraft than in the cabin?

@TWMBooth FACT: placing lithium ion powered devices in the hold is a greater risk to the travelling public.

@paulwoodford Battery fire risk same in cabin but would be noticed sooner and presumably dealt with by crew. Smokers in lavs a greater danger.

@warfaresims [On restarting F-22 production] Is this still feasible? Status of tooling etc?

@russHughes66 [On Dubai's flying taxis⁽⁴⁾] Great article in @AeroSociety magazine about single passenger drones coming in #Dubai next! @HHShkMohd has such amazing plans! #avgeek

@McParlinStephen [On Norwegian using 737 MAX on transatlantic routes] That depends whether point-to-point flying beats hub-and-spoke for transoceanic ops. ATC capacity an issue.

Gladiator director to film new Battle of Britain movie



While the 1969 Battle of Britain film featured real aircraft will any proposed Sir Ridley Scott film rely more on CGI techniques?

@Gallowayastro [On Sir Ridley Scott to direct new Battle of Britain movie] Remember the Hurricane pilots and please please please use real planes more than CGI ones.

@48_enever Well he did make Blade Runner and Alien and he is English, so we will see. Just hope he remembers Pearl Harbor that's all.

@thomas_ingleton Will it have real Spitfires and Hurricanes?

@bandit4470 Of course not. It'll have bloody Mustangs defeating Messerschmitts. Over New York, obviously.

@ByBenGriffiths Would be undoubtedly awesome! Hopefully not too much CGI a la Red Tails.

@MattNixson Red Tails was awful! Shame no-one flies the bombers anymore. Wasn't Spain still flying Heinkels when Battle of Britain was filmed?

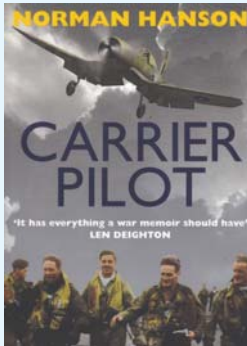
@GetIntoFlying I'd settle for a more accurate portrayal of air combat rather than a couple of aircraft flying close trail for five minutes!

@NZAircraftFan It will be difficult to find old airfields that haven't been turned into housing estates to shoot this film.

@TheDashingChap I mean, IMAX cameras strapped on to an actual Spitfire? Gibbering with excitement!

@KlingKlang1968 Hopefully no CGI graphics #repeatplease.

United Artists



@nickadklam123 [On Norman Hanson's WW2 memoir *Carrier Pilot*] It is a superb book, well written and absolutely eye opening to the horrors of the war in the Far East.

@RowlandWhite Listen out for the @RAeSTimR review of Norman Hanson's *Carrier Pilot* at 58.58 on @AviationXtended. Compares it to Geoff Wellum's classic *First Light*...

@reaktionbooks Delighted to see *Satellite* recommended by the experts at the National Aerospace Library @AeroSociety. bit.ly/2o1LH1B

@ste_barnes [On 'New materials, structures & manufacturing for aerospace' – Seminar, RAeS Sheffield Branch] Interesting day and some great speakers. Thanks @AeroSociety!

@phil_amrc @Prof IainTodd presents control of microstructure in additive manufacture to @AeroSociety structures and materials group conference @TheAMRC

@PaoloNurra [On Wright Electric promised London-Paris electric flights in ten years] In ten years? I bet it will take a little more if the aircraft are of the size in the picture.

@F1isP1 Agree – plenty of reasons listed in article why it won't happen in ten years.

@PeterSharpe11 It will need 1,686,790kg of lithium ion batteries to carry same 'fuel' as 6,400 gallons of kerosene that A320 carries.

@hervepmorvan In fairness to Wright, though focus of news was on batteries, their aircraft seem to be hybrid electric, with batteries used for limited and specific activities. This is aligned with current thoughts on more electric. Short haul electric very feasible, indeed at the 20+ year horizon and a key area of research focus for @UoNAerospace.

@LancasterDV403 Great @AeroSociety talk 3 April by Taylor Downing @ComdtCranwell on photo recce. Thanks to Calum in Daedalus Mess for sorting problems.

@MehdiAsareh [On Better connections⁽⁶⁾] Good article by Bill Read in @AeroSociety's *AEROSPACE* mag, on new enhanced satellite broadband and inflight Wi-Fi systems.



An EU research project led by The Netherlands NLR has proposed the use of circular runways.

@teaselstudio1 [On Circular runways blog⁽¹⁾] You could kiss your open packet of peanuts goodbye – ping off the outer windows like bullets.

@TWPILOT1 LVP operations would be impossible.

@CcibChris With a 50kt wind, what is the target touchdown from what precision approach?

@enbikelopedia It'd be fitting as @IMS started as a hot air balloon aviation test site.

@amob72 If the circular runway needs maintenance, what will be the back-up runway?

@martinvars 4km long circular runways with terminals inside the ring are pure genius. An endless runway!!!

@TheVVOldGuy Sorry, folks. I may never fly again. This sounds like a totally cockamamie idea.

@BryceRemkes As a professional pilot, both former military and civilian, this is dumbest aviation idea ever. #idiocy

@radiradi From a capacity and ground movement point of view it looks lovely. Me landing on it, not any time soon!

@Avgyk Imagine landing in a heavy cross wind.

@pjennney58 Wow, that would really wake up the sleeping passengers. The already awake ones would have fun, roller coaster! #SILLYIDEAS

@tangofoxtees If we wanted to watch expensive accidents on a circle or oval, there's always @NASCAR & @IndyCar

@eksyau We should let the EU member states to test the circular runway before bringing this concept to the UK.

@AeroSquip Round the pole ... Attach a long length of string to the roof of air traffic and other end of string to wing tip and go for it?

1. <https://www.aerosociety.com/news/would-circular-runways-drive-pilots-round-the-bend/>
2. <https://www.aerosociety.com/news/revamped-raf-air-power-conference-to-set-scene-for-centenary-in-2018/>
3. <https://www.aerosociety.com/news/will-security-theatre-of-the-passenger-electronics-ban-bring-the-house-down/>
4. *AEROSPACE*, April 2017, p 14, Dubai's flying taxis
5. *AEROSPACE*, April 2017, p 34, Better connections



Online

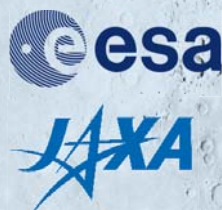
Additional features and content are available to view online at <http://media.aerosociety.com/aerospace-insight>

Mercury Rising

BepiColombo, an ESA/JAXA collaboration, is on a mission to become only the third man-made spacecraft to Mercury and Europe's first. SARAH CRUDDAS explains more about BepiColombo's investigation of the first rock from the Sun and what it hopes to discover there.

As far as planets go, Mercury appears to get the raw end of the deal. The closest planet to our Sun, it has no choking thick toxic atmosphere like its nearest neighbour Venus. Nor does it have unimaginably strange ice volcanoes – known as cryovolcanoes – like Pluto, yet another world once seen as dull and uninteresting. Even compared to some of the moons that we know of, such as icy Europa – likely one of the best candidates for life in our Solar System, or fiery Io – the most volcanic world we know of, Mercury on the surface just seems a little dull. However, a new space mission known as BepiColombo is set to make this so-often overlooked world exciting again. As well as helping to answer questions about the existence of our own planet and providing support for one of the most fundamental questions of all humanity; are we alone?

BepiColombo



BepiColombo will be transported into orbit by esa's heavy lift launch vehicle, Ariane5. It is scheduled for lift-off from Europe's spaceport at Kourou, French Guiana, in October 2018.



To date only two spacecraft have ever visited Mercury; Mariner 10 in 1974 and Messenger in 2011, both led by NASA. BepiColombo will be Europe's first mission to the inner most planet. Its name is in honour of the man who made our first ever mission to Mercury possible, Italian mathematician and engineer Giuseppe Colombo (1920-1984), who was better known by his nickname Bepi Colombo. It was Colombo who is best known for his work on the planet and his calculations which enabled the success of the Mariner 10 mission. For his namesake's mission, the aim is simple; to explore the least known of the terrestrial planets in unprecedented detail.

Ship to Mercury

Currently scheduled for launch next October, the European Space Agency (ESA) is working in close co-operation with the Japanese Space Agency (JAXA) developing not one but two spacecraft to send to the little-explored world, which will operate in two different orbits. The Mercury Planetary Orbiter (provided by ESA) is designed for remote sensing while the Mercury Magnetospheric Orbiter (provided by JAXA) is designed for the study of the magnetosphere. Both craft are needed to help mission scientists begin to draw conclusions on the the formation and evolution of Mercury



Airbus Defence and Space

This artist's view shows the two BepiColombo orbiters (MPO and MMO) mounted on top of their transfer module, forming one single composite spacecraft.



NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington

A familiar face from the surface of Mercury.

and build up a complete description of the planet and its environment. "The BepiColombo mission shall provide the detailed information necessary to understand Mercury and its magnetospheric environment and to find clues to the origin and evolution of a planet close to its parent star," explains BepiColombo Project Scientist, Johannes Benkhoff.

With its comprehensive instrumentation, BepiColombo will provide high-resolution global mapping of the planet surface. It is a flagship mission for the ESA, with a triple link radio science instrument together with an accelerometer to correct the disturbance of the spacecraft by the solar wind will allow high-precision measurements of Mercury's gravity field. It is the twin spacecraft approach that will enable the study of Mercury's magnetosphere. "The instrumentation is very comprehensive and state of the art. We also have several instruments on both spacecraft which were not present on Messenger. Thus, I strongly believe that the instrumentation of BepiColombo is perfectly suited to obtain our science goals and to deliver answers to the necessary and also new questions raised by Messenger," adds Benkhoff.



Professor Giuseppe Colombo (ESA)

More than a small interest

With all the exciting unexplored places of our own Solar System, is Mercury really that exciting? "While a trip to Mercury may not be on the bucket list of many astronauts, learning more about this small world is most definitely of interest to astronomers.

This is only partly because of the natural curiosity we have for a neighbouring planet," explains Senior Astronomer for the SETI Institute Seth Shostak.

Scratch beneath the initial impressions and Mercury begins to become fascinating. It is a place of extremes and scientists want to know why. A rocky airless world on the outside, that looks just like our Moon, where temperatures vary from -173°C at night to 427°C during the day. On the inside, it resembles Earth, with an iron core much larger than our own and undergoing strong solar influence. It is the only planet other than Earth with a strong magnetic di-pole. According to ESA's Chief Scientist and Senior Exploration Officer Bernard Foing; "Mercury can give clues on the structure and evolution of inner planets."

Presently the least known and explored planet in the inner solar system even after NASA's successful Messenger mission, a precise characterisation



THE BEPICOLOMBO MISSION SHALL PROVIDE THE DETAILED INFORMATION NECESSARY TO UNDERSTAND MERCURY AND ITS MAGNETOSPHERIC ENVIRONMENT AND TO FIND CLUES TO THE ORIGIN AND EVOLUTION OF A PLANET CLOSE TO ITS PARENT STAR.

Johannes Benkhoff
BepiColombo Project Scientist



SPACE

Mission to Mercury



BepiColombo (2018)

Launch Date: October 2018 **Mission Type:** Flyby, Orbiter

Launch Vehicle: Ariane V

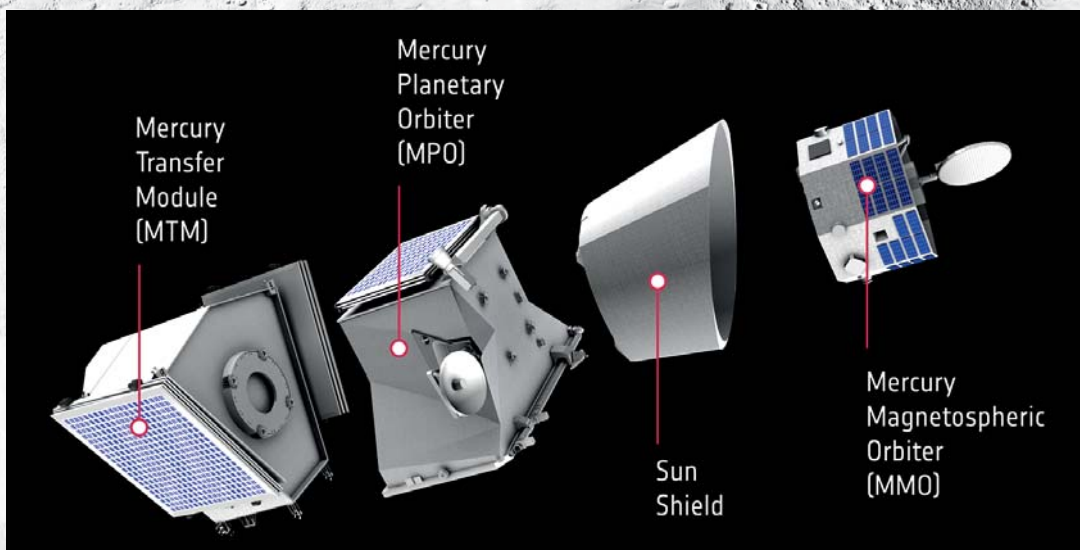
Launch Site: Guiana Space Centre ELA-3

Spacecraft Mass: Mercury Planetary Orbiter (MPO): 520kg Mercury Magnetospheric Orbiter (MMO): 250kg

Maximum Power: MPO: 600W MMO: 325W

Maximum Data Rate: MPO: 50 kilobits per second MMO: 5 kilobits per second

The composite ESA/JAXA BepiColombo spacecraft comprises the Mercury Transfer Module (MTM), the Mercury Planetary Orbiter (MPO), a Sun Shield and the Mercury Magnetospheric Orbiter (MMO). In fact, the BepiColombo mission is based on two spacecraft: the ESA-led MPO, a three-axis stabilised and nadir-pointing spacecraft with 11 experiments and instruments, and the JAXA-led MMO, a spinning spacecraft carrying a payload of five experiments and instruments.



of the planet is long overdue. "Being the planet closest to the Sun it represents the inner end-member of the four terrestrial planets. As such it plays a fundamental role in constraining and testing the competing theories explaining dynamical and compositional aspects of the formation and evolution of the whole group," says Benkhoff, "Its evolution history is therefore an important piece in the puzzle?". Added to this is the fact that Mercury has no atmosphere. 'What happens on Mercury, stays on Mercury'. The closest rock from our sun is a time capsule for events more than 4.5bn years ago when our Solar System was formed. "A solution to the great puzzle of planet formation may be written in its craggy face," believes Shostak.

Rock in the Solar System

Knowing more about Mercury's surface composition will also help to provide a key test of competing models for the formation and evolution of the planet as well as the other terrestrial worlds including our Earth. According to Benkhoff; "Mercury's interior structure will be investigated by the radio science experiment in combination with the laser altimeter and the high-resolution camera." Together these instruments will, for the first time, provide an accurate determination of the global gravity field and the rotational state of the planet. "Mercury can be seen as one end-member of our planetary system. Thus, understanding Mercury's evolution will for sure contribute to a better understanding about solar system formation."

It is not just about learning more about Mercury, or indeed the inner planets. As with all space missions, the spin-offs in technology bring huge benefits to life on Earth, in terms of pushing forward human endeavour in technology, helping to enrich life for all of us. There will even be an opportunity to test Einstein's Theory of Relativity. Perhaps most

tantalising of all is the possibility that learning more about this rocky airless world could help in our search for life elsewhere in the Universe.

It is safe to say that Mercury never could have supported life – at least as we know it. Its proximity to the Sun renders it too hot and radiation levels and surface temperature would preclude 'standard' biology from ever having taken hold there. That doesn't mean there couldn't be something similar to Mercury elsewhere in our Universe but in just the right place and, with slightly different conditions, that could harbour some form of life. "The really compelling reason to check out this neglected world is because of what we might learn about many of the trillion or so other planets that clog the Milky Way" believes Shostak. On Earth we have now learned that our own magnetic field is essential – not just for aligning compass needles but for shielding Earth's flora and fauna from deadly, high-energy particles. "no-one expected Mercury, whose iron core is presumably as solid as the Bank of England, to have a magnetic field. How does this happen and would this bode well for the chance that small planets around other stars could be suitable for life?"

Long time no see

So, if Mercury offers so much potential, why have we not been sooner? There was a 36 year gap between the end of the Mariner 10 mission, which concluded in 1975 and NASA's Messenger mission. Budget constraints for scientific missions aside, it's simply not easy to send a spacecraft to Mercury and put it into an orbit around the planet. "The spacecraft must brake against the Sun's gravity, which increases with proximity to the Sun, rather than accelerate away from it, as is the case with journeys to the outer Solar System", explains Benkhoff. It turns out that sending a spacecraft to Mercury requires more fuel



IT TURNS OUT THAT SENDING A SPACECRAFT TO MERCURY REQUIRES MORE FUEL THAN SENDING A SPACECRAFT TO PLUTO!



MESSENGER (2004)

Launch Date: 3 August 2004 **Mission Type:** Flyby, Orbiter
Launch Vehicle: Delta II 7925H-9.5
Launch Site: Launch Pad 17B at Cape Canaveral, FL, USA
Spacecraft Mass: 507.9kg
Maximum Power: 640W
Maximum Data Rate: 104kb/s



Mariner 10 (1973)

Launch Date: 3 November 1973 **Mission Type:** Flyby
Launch Vehicle: Atlas-Centaur
Launch Site: USA, Launch Complex 36B, Cape Canaveral, FL, USA
Spacecraft Mass: 502.9kg
Maximum Power: 820W at encounter
Maximum Data Rate: 117.6kb/s

than sending a spacecraft to Pluto! To get over this first challenge BepiColombo will make clever use of the gravity of the Earth, Venus and Mercury and by using solar electric propulsion – or SEP for short!

Add to this yet further challenges, for example; 'a very large velocity increment is needed to go to Mercury of 8km/s.' because it takes Mercury around 56 days to fully rotate on its own axis, this exposes the BepiColombo to extremes of temperatures. Being the closest planet to our Sun, this brings in yet further challenges. "The radiation environment around the Sun is very challenging. High temperatures together with the UV radiation of the Sun forced industry to develop special materials and protections for many components", says Benkhoff. The thermal insulation blankets which have been developed for the craft have more than 60 layers and need to withstand temperatures of almost 400° throughout the mission.

The planet is also inaccessible for the large ground-based telescopes as well as the Hubble Space Telescope. This is because, from the Earth, Mercury's maximum elongation to the Sun is 28°. This means it is therefore visible for just two hours at most and at very low altitude either before sunrise or after sunset and none of these telescopes can take measurements this close to the Sun.

The previous missions to Mercury succeeded and they have laid the foundations for not only the technology being developed for BepiColombo but also the type of research and instrumentation that needs to be developed for this mission.

From Mariner 10 we learned about using gravity assist to reach other planets in our Solar System. The craft was able to visit Mercury after using the gravity of Venus to assist it on its way, a technique now commonplace for space missions. Mariner 10 revealed for the first time for all of us back on Earth what the closest planet to our Sun looked like. A rocky Moon-like surface, with craters, ridges and chaotic terrain. It revealed the planet's weak magnetic field and, at its closest, Mariner 10 was just 703km from its surface. The spacecraft used the pressure of the Sun on its solar panels and high gain antenna like a solar sail for altitude control. An incredible achievement in exploration when you consider that 16 years before it had launched, only Sputnik had left the confines of our home planet.

Then came a break of more than three decades before NASA launched **Messenger**. The goal to explore the smallest densest and least explored planet, and its ending in 2015 saw the craft smash into the surface of Mercury. As well as bringing back the most incredible images to date, among the plethora of achievements and discoveries, included the discovery of a Great Valley and the first global topographic model, was confirmation of water ice in some of the polar craters unthinkable but true for the planet closest to the Sun. Even though the mission is now over, data is still coming back: "We

have recently seen some fantastic, yet unexpected results. For example, they found much more volatile material on the surface of Mercury than presumed by scientists so far. This result is completely incompatible with current formation theories and could indicate that all formation theories need to be rewritten." adds Benkhoff.

The long-awaited return

So much awaits this third mission to a rocky world smaller than some moons and just 58m km from our Sun, as we slowly begin to build up an understanding of the planet as part of the bigger jigsaw puzzle of piecing together clues about the objects in our Solar System, the universe beyond and life itself. Back on Earth, BepiColombo which, if the launch schedule is kept, will likely arrive in the



Artist's impression of BepiColombo – ESA's first mission to Mercury. It will be conducted in cooperation with Japan. ESA's Mercury Planetary Orbiter (MPO) will be operated from ESOC, Germany.

mid-2020s, will also act as a boost for planetary science in Europe. Traditionally this has been an area where the US leads the way but the hope from those on the project is the high technology and leading edge of the mission will help to inspire a 'can do' attitude in Europe.

However, as the saying goes, 'space is hard'. Yes, it is so often over used but it is simply true. We have only been exploring space for shy of 60 years. Our reconnaissance of the classical planets (including Pluto) was only completed in 2015 with the success of Horizons 2015. In terms of becoming a spacefaring species we are still in our infancy. There will be challenges with BepiColombo, hard technical challenges because of the travel, the close proximity to the Sun and the high temperatures the craft will face. It is BepiColombo and this new era of planetary science missions which will truly help push us forward in our understanding of the Solar System, as well as inspiring many more to reach for the stars.

● PLANE SPEAKING

Mark Burns



Gulfstream



Gulfstream

Plane speaking with Mark Burns

We spoke to Gulfstream Aerospace President, MARK BURNS about development of its new G500 and G600 business jets, the pre-owned market and the outlook for business jet manufacturing.

AEROSPACE: You have been in post now since February 2015. What have been your highlights so far?

MB: I have experienced many great moments over those nearly two years. Many of them have to do with our two in-development aircraft, the Gulfstream G500 and G600. I have watched four new flight-test aircraft join the G500 test program, putting that aircraft well on its way to earning type certification from the Federal Aviation Administration later this year.

Along those same lines, we closed 2016 with the first flight of the Gulfstream G600 on 17 December. Seeing that aircraft take off from Savannah was breath-taking, especially since the chase plane was the Gulfstream G500. It was a truly incredible experience to stand side-by-side with our employees and see their excitement. Even though it was a Saturday, we had quite a crowd assembled to watch these two aircraft. It demonstrated the dedication and commitment of our employees that they would come out on a Saturday to watch an aircraft take off.

That brings me to my next highlight: getting to lead such an incredible team of people, many of whom I've known for years. Every day, I meet and interact with the brightest minds in business

aviation, and it's just an honor to know I'm part of their team. They have a commitment to Gulfstream and to excellence that is second to none. I feel very fortunate.

AEROSPACE: The business aviation industry is still reeling somewhat from the 2008 financial shock. How has Gulfstream weathered the storm?

MB: We haven't been without challenges, but ultimately, I think we have continued to be a leader in the business aviation industry. There are a number of reasons for that. First and foremost, we have a tremendous partner in our parent company, General Dynamics. They have a long-range plan and stick to it. So, while other companies were pulling back, we were going forward, carrying out two aircraft development and flight-test programs: the Gulfstream G650 and the Gulfstream G280. We were also in the midst of developing the G500 and G600, although those programs were not public at the time. Thanks to General Dynamics, we invest for the long-term, dedicating a consistent flow of resources to researching and developing new aircraft, new technologies and new services that provide value to our customers.

Top left: Gulfstream Aerospace President, Mark Burns.

Top right: G500.

Top opposite page: G600.

Lower opposite page: Gulfstream G500/G600 production line.



Beyond that, I think we are most disciplined in our production and business practices, especially when it comes to establishing manufacturing rates and aircraft pricing, retaining our customers' residual value and setting a prudent trade-in policy. And, finally, we're committed to delivering on our promises, and even exceeding them. The investments we've made in our ground-based labs, our employees' development and our flight-test programme for the G500 and G600 reflect that commitment and have allowed us to move customer deliveries up to 2017 and 2018, respectively.

AEROSPACE: With the industry still sluggish, has the pre-owned segment impacted on sales on new aircraft?

MB: The used aircraft market is very active. We see transactions related to pre-owned aircraft come through our service centres on a daily basis. The value in the pre-owned market is something our customers always consider in today's market. The products we have, such as the G650, G500 and G600, enable us to compete with new technologies and innovations that aren't seen in the larger portion of the pre-owned market.



I THINK WE'VE WORKED HARD WITH INDUSTRY ORGANISATIONS TO INFORM MEDIA AND POLITICIANS ABOUT THE STRATEGIC BENEFITS OF BUSINESS AVIATION AS WELL AS ITS IMPORTANT ROLE IN THE WORLD ECONOMY.

Mark Burns
President
Gulfstream Aerospace

AEROSPACE: A couple of companies are now aiming to bring supersonic flight back and NASA is working on a quiet supersonic X-plane. Are you tempted to revisit Gulfstream's supersonic research in the area?

MB: Ever since Gulfstream developed the Quiet Spike sonic-boom mitigator in 2006, it has had a small team dedicated to researching sonic-boom mitigation and working with the authorities to remove the ban on flying supersonically over land.

AEROSPACE: As well as VIP and corporate customers, Gulfstream also supplies military and government customers with special mission aircraft. What is the current split between your civil and military sales? Do you see that balance changing as some customers mull replacing larger aircraft (eg JSTARS) with bizjets?

MB: Government and special mission aircraft represent a small, but important, portion of our worldwide fleet. Our Gulfstream G550 is the ideal platform for special missions thanks to its ability to fly at higher altitudes, achieve higher speeds and fly longer ranges. Combine that performance with an unrivalled cabin environment – low cabin altitudes and 100% fresh air – and you have the perfect platform to support a wide range of special mission applications, including medevac; conformal airborne early warning (CAEW); atmospheric research; maritime patrol and surveillance; and intelligence, surveillance and reconnaissance (IS&R). In the US alone, Gulfstream aircraft serve the military as well as several government agencies.

AEROSPACE: How do you think new President Trump will affect business aviation? On the one hand he seems to be an enthusiastic user of business aviation – but on the other are you worried that US protectionism could end up damaging key markets – for example China?

MB: We have seen positive economic signs following the US Presidential election, but it is too soon to tell how this will impact our business and the industry over the long-term. We'll continue to work with advocacy groups, such as GAMA and NBAA, to create awareness around the needs of the business aviation community and to represent the industry on policies that could impact our business. Business aviation needs to be recognised for the high-tech jobs we have and continue to create, which helps our economy.

AEROSPACE: China and the Asia-Pacific are big markets for Gulfstream. What is the reason for your success there – given that it seems that many buyers went direct to large-cabin aircraft, rather than 'trade-up' in size?

MB: We made a decision to invest in the China market many years before the China

● PLANE SPEAKING

Mark Burns



Founded: 1958

Headquarters:
Savannah, Georgia, US

Parent Company:
General Dynamics

Revenue of General Dynamics's aerospace division (inc Jet Aviation): \$8.362bn (2016)

Aircraft delivered: 115 (2016)

Number of employees: 13,313 (2014)

business-aviation market developed. We delivered our first aircraft there in 2003 and we've been there ever since, building our presence and investing for the long-term. We were the first original equipment manufacturer to open a service centre in China, Gulfstream Beijing, and it's doing well. Since it opened in 2012, we've serviced more than 600 aircraft there. We have more than 75 people based in Greater China with offices in Beijing and Hong Kong, as well as an Asia Customer Contact Centre with nearly ten people. Ultimately, the investments we've made have earned us solid standing with our customers and a 70% share of the large-cabin market. Of course, it goes without saying that the performance, reliability, safety, quality and craftsmanship of our aircraft are at the centre of our success. Our long-range aircraft are ideally suited for customers in China due to their tremendous range and speed, which allow customers to fly from there to Europe, Africa or North America nonstop.

AEROSPACE: Business jets often pioneer some of the latest aviation technology first. What can we see from Gulfstream's latest aircraft that will end up going mainstream? What percentage of your profits do you invest in R&D?

MB: Over the past decade, thanks to our parent company General Dynamics, Gulfstream has invested significantly in its research efforts, with more than 1,500 engineers and designers working at our Research and Development Centre campus. The campus was established in March 2006 with a single office building and over time has grown to include three office buildings, a dedicated lab facility and the G500 and G600 building, which combines the two and puts our engineers and pilots in the same facility as our ground-based labs. I think some of the innovative technologies we've developed in those labs and introduced on the G500 and G600 will work their way into the mainstream. The G500 and G600 will have the first active control sidesticks

in business aviation, and it would be wonderful to see that technology, which enhances safety, find its way into the broader aviation community. I believe the continued and consistent investment in our engineering workforce has created an environment of learning. This makes our products better and our company stronger.

AEROSPACE: Can you give us an update on the new G500 and G600 models as they progress through flight test? Are there any special challenges in conducting two near-simultaneous flight test campaigns?

MB: The G500 and G600 are doing extremely well. So well, in fact, that we were able to move up their entry-into-service dates to customers. There are five aircraft flying in the G500 programme, including one with a fully outfitted interior. As of late March, those aircraft had accumulated more than 2,600 hours of flight time. The G600 programme is doing equally well, with two aircraft flying and a third about to be. Since we launched the flight-test programme for the G600 in late December, the aircraft have achieved more than 200 hours of flight time.

AEROSPACE: Gulfstream has made a name for itself in long-range, large-cabin aircraft. How do you see this market evolving in the future? What will customers ask for – even more range, faster onboard connectivity, more safety features?

MB: It's difficult to know just what customers will ask for next. That's why we make them part of our design process through our Customer Advisory Board and our Advanced Technology Customer Advisory Team. It was the feedback from those teams that helped us design the Gulfstream G650. Customers told us they wanted to go farther faster, and the G650 was born. We continue to work closely with them to ensure we're incorporating their feedback into future designs.

A Gulfstream G280.



AEROSPACE: What do you think makes Gulfstream stand-out from its other business aviation competitors?

MB: I think what differentiates Gulfstream is the commitment of our employees to delivering on our promises. All of our in-production aircraft entered service on time with capabilities that met or exceeded what we promised. The G650, for example, had 1,000nm more range than we promised (6,000nm vs 5,000). With the Gulfstream G550, we delivered the PlaneView flight deck with enhanced vision, an industry first. With the G280, we delivered 200nm more range. It's important for us to create value for our customers by listening to what they want and ensuring we deliver it. Our people make this happen.

AEROSPACE: What would you say to those critical of business aviation as 'rich boys toys'? Should the industry be doing more to change its image and explain its social and economic benefits to media and politicians?

MB: Those critical of business aviation do not understand the benefits of our products and services. It's proven that companies using business aircraft grow faster and create more jobs. Safety, flexibility, reliability and performance are important whether you're traveling for business or pleasure. I think we've worked hard with industry organisations to inform media and politicians about the strategic benefits of business aviation as well as its important role in the world economy. Gulfstream alone employs some 15,000 people around the world. General aviation as a whole employs more than 1.1 million and makes a total economic contribution of more than \$219bn. Business aviation is a cornerstone of our worldwide economy.

AEROSPACE: Following on from that, aviation as a whole is facing a skills crisis and a shortage of young people entering this industry. What is Gulfstream doing to attract the next generation into aerospace and specifically business aviation?

MB: We have a number of programmes in place that we hope will get the next generation of bright young minds interested in aerospace and business aviation. We have a Youth Apprentice program that allows local high-school students to split their time between school and working at Gulfstream to gain real-world experience and hands-on mentoring. Right now, we have apprentices working in 37 different job functions, including quality control, accounting, aircraft maintenance operations and engineering.

We offer dual high school and technical college enrollment, which allows high school students with an interest in technical jobs to take courses at one of Georgia's technical colleges to earn credits



A Gulfstream G650.

toward both a high-school diploma and a technical college degree.

We also collaborated with local business to launch a program of our own called the Student Leadership Program. In that program, we mentor high-school students, helping them develop life skills, explore available career paths and develop a post-graduation career plan. We started the program in Savannah, Georgia, which is home to our headquarters, and then expanded it to Brunswick, Georgia, and Appleton, Wisconsin.

We also have Job Shadow Programs at our facilities in Westfield, Massachusetts, and Dallas, Texas. Preparing the next-generation workforce is a priority for Gulfstream.

AEROSPACE: We are heading into EBACE in May. What aircraft will Gulfstream be taking there and what will the big message be?

MB: We will have the four-living-area Gulfstream G650ER, the Gulfstream G550 and the Gulfstream G280 on static display. If the testing schedule allows, we may bring a Gulfstream G500. Our focus will be on our flight-test programs, as we systematically march through key test points *en route* to customer deliveries at the end of 2017 for the G500 and 2018 for the G600.

AEROSPACE: Finally, what do you perceive as the biggest challenge facing business aviation today?

MB: The biggest challenge any business aviation company faces is to develop new products and services that customers need. In my almost 35 years in this industry, I have seen markets move up and down. To ensure success in any market conditions, you must have products and services that are high quality, reliable and innovative. I am confident the G650, G500 and G600 will be successful in today's market.

Flight design

TONY BISHOP reports on The RAeS General Aviation Group Design Competition which aims to stimulate innovative designs and interest in using E-Conditions for proving new concepts in the air, and hence revitalise the UK's GA industry.

Throughout 2016, design teams were hard at work on their entries. The rules invited any fixed-wing aircraft design that came within the new E-conditions which allow experimental aircraft of under 2,000kg to be designed, built and tested with the absolute minimum of paperwork.

The entries had to follow the format of an actual E-conditions submission:

1. Concept sketch
2. Details of the aircraft
3. Flight test programme
4. Risk assessment

and, in addition, a business case.

Entries from commercial companies and higher educational institutions had to complete all parts.

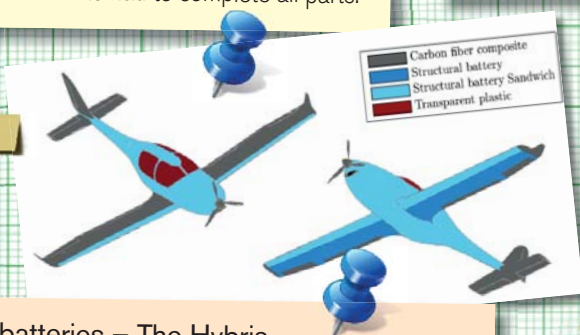
Entries from schools and groups of individuals just needed the business case and parts 1 and 2. A total of eleven initial entries were received and seven submitted full entries.

The big innovation themes were electric and hybrid power and carbon composite structures which were used in all the entries. Dramatic reductions in battery costs, along with a slow but steady increase in energy per unit weight, now make electric power much more attractive. Small, light, electric motors allow the power to be distributed, allowing many innovative configurations. This was featured in three entries.

The judges were impressed by the quality of all the entries and commended them all. Choosing from the award winners was not easy.

Below: The winning team from Polytechnic University of Milan.

The Hybris



1. Built with batteries – The Hybris

A team of students won the competition with this four-seat design. It is aimed at the training and leisure markets currently dominated by Piper and Cessna aircraft. These typically have a range of 500nm and a cruise speed of at least 100kt.

This entry was aimed well into the future, using batteries that form much of the secondary structure. This is still in the research labs, so will be a few years coming. Each battery cell has a carbon composite component which is designed to form part of the aircraft structure. Most of the fuselage skin and much of the wing skin are made from these structural batteries – in areas carrying lower stresses.

It uses a hybrid powertrain, with a 200kW ENSTROJ Emrax 268 MV CC Avio electric motor. A Continental CD-155 drives another Emrax, this time used as a generator. It runs at a continuous 71kW to recharge the batteries in the cruise. 116kg

of Kokam lithium-ion batteries use carbon composites for both structural strength and as a battery component. These are supplemented by an additional 44kg of conventional batteries. The total energy stored is 25kWh. In pure electric form and with a conventional structure, the aircraft has only 300nm range. This is increased to 500nm using structural batteries and a hybrid configuration.

The estimated selling price is about £410,000; slightly higher than the Cirrus SR22 and Pipistrel Panthera. Operating cost is predicted to be about 20% lower than a Cirrus SR22.

The judges particularly liked the thorough approach taken by the team, from the comprehensive market survey, through the detailed assessment of how to incorporate the structural batteries, to the operating cost analysis.



2. Multiple motors – the Pegasus VI

Team Pegasus is a Bristol team that came second with the Pegasus VI. This is an aircraft aimed at the fractional ownership/charter market, and accommodates a pilot and five passengers. Its range is 700nm and it is designed for small fields and short turnaround times. This is the market currently dominated by the Cessna 208, Piper PA-46 and Cirrus SR22.

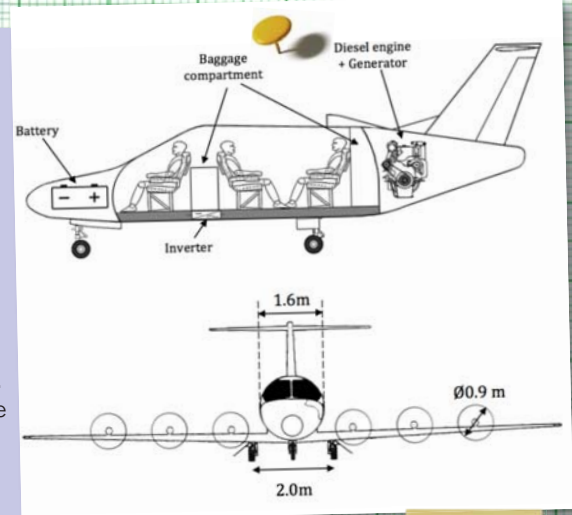
This should be a feasible proposition within a few years if several development hurdles can be overcome. It would introduce digital fly-by-wire to much cheaper aircraft than possible until now. Another novel feature is the wing, which is blown by multiple propellers at low speed and also uses variable geometry to achieve a stall speed of 46kt and short field performance of 300m.

The six motors provide a total of 225kW during take-off. An Austro Engine AE300 diesel, scaled to 135kW, is used to reduce cruise fuel and is sized for cruise at 155kt. It generates power for the batteries. The 45kWh batteries weigh 71.5kg, and provide extra power for take-off and climb. They are re-charged during descent to provide enough power for a go-around.

The structure is of carbon fibre and foam core, using resin infusion manufacturing to reduce costs. Attachments in the landing gear, control surfaces and pylons are of titanium, made using additive layer manufacturing (ALM).

Team Pegasus believe that they can develop and test a prototype for a total of £3m and meet a target selling price of £500,000.

The judges were impressed by the range of innovative features incorporated by the team but wondered whether so much development was achievable within the budgeted development cost. This entry also included a good risk assessment.



The Pegasus VI

3. Panoramic pleasure – the fliMAX

The Cambridge-based fliMAX team came third with a design focused on the sightseeing market. These flights in places like the Grand Canyon are severely limited by noise. But they're also quite short, and flown at low speeds, so ideal for an all-electric aircraft. It's designed for quick turnarounds and short fields.

Seating is for a pilot plus two or three passengers. The passengers' seats are raised to provide a panoramic view through the large glazed area. They have screens, showing the view through a high quality camera on the nose, which they can control with a joystick to record images and videos. IFR capability means that it can be used to watch the night sky.

It's designed around existing technologies and components. The base version is powered by four Joby JM2 motors on the tail (for minimum noise) with continuous power of 19kW each. Energy comes from 34kWh of Kokam batteries. Duration is one hour plus reserves, with a cruise speed of 85kt.

A second version is aimed at the leisure pilot and observation markets. This uses a light-weight 30kW Wankel engine to recharge 12kWh batteries and to provide cruise power for 100kt over five hours with 61kg of fuel.

The throttle can demand regeneration on the descent and reverse thrust. Brakes are replaced by electric motors, which can be used for efficient taxi and initial take-off as well as braking. The rudder is fly-by-wire and backed up by differential motor power.

The carbon fibre structure is cured at high temperature so that the aircraft can be painted any colour and kept outside. Additive manufacturing is used to make several complex parts in aluminium and titanium.

Selling price is around £250,000 and development costs about £2.5m.

The judges felt this was clearly the best of the group/individual class of entries. The selected market niche is an interesting one but, as always with any unproven market, it is difficult to forecast demand. The use of current technology and components is clearly an advantage.



The fliMAX

● GENERAL AVIATION

RAeS Design Competition

Electrifying electrics – The Electroflight P1e

Electroflight Ltd, led by Roger Target, aim to 'design and build the world's fastest, most innovative, electric powered aircraft', which will set speed and time-to-height records and go on to establish a new form of air-racing. He's already done much development work, and has been widely publicised. (see 'Bright Sparks', *AEROSPACE*, March 2017).

The aim is to achieve 250kt at sea level and climb (vertically!) at 9,000fpm. It's a single seat aircraft, designed for $\pm 15g$, using two co-axial motors generating a total 244kW to drive contra-rotating propellers. The structure is carbon/honeycomb sandwich.

Roger is actively seeking funding for this record-breaker.

The Electroflight P1e



Electric rain – University of Liverpool

A team from the University of Liverpool targeted the cloud-seeding market, a five-seat aircraft cruising at 170kt and climbing to 25,000ft for a 500nm cruise. Power is from a 260kW Siemens electric motor.

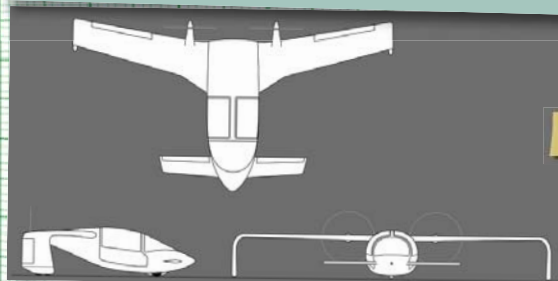
The Electric rain



Canard for oldies – Gemini

Andy McKee designed the Gemini for ageing private pilots who want an accessible, comfortable and ergonomic light aircraft and, of course, have the money to pay for it. It has keyless entry and a much-simplified cockpit. The canard configuration prevents stalls. Twin electric pusher motors at the back provide the thrust, minimising cabin noise. Cruise speed is 150kt with a range of 700nm. The rear wheels are under the fins ('though not clear how it rotates on take-off), providing a very wide track. Batteries are charged by a turbo-diesel.

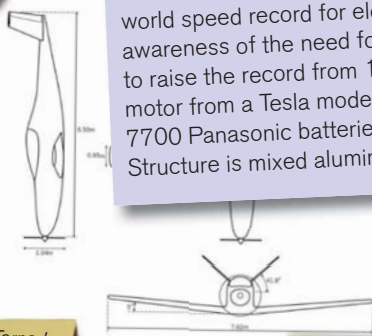
Gemini



Tesla Tornado – University of Liverpool

Another team from Liverpool also set about the world speed record for electric aircraft to raise awareness of the need for greener aircraft. It aims to raise the record from 174kt to 200kt. It uses a motor from a Tesla model S car, rated at 310kW, and 7700 Panasonic batteries to give 80kWh of energy. Structure is mixed aluminium alloy and carbon fibre.

Tesla Tornado



Think you can do better?

The 2018 RAeS Design Competition

The next RAeS General Aviation Design Group Competition will be announced in September. You can enter as a corporation, academic institute, or one or more individuals. Just dream up an innovative new aircraft or modification to an existing aircraft. It can be fixed-wing or not and it can use any power source. It just has to be with E-conditions.

We plan to keep the rules the same each year, so that whenever your idea occurs, there'll always be another competition to enter. Academic institutes can also encourage student projects every year.

Entries should be sent to:
conference@aerosociety.com

General Aviation Group AGM

The GA Group will be holding its AGM at 4pm on Thursday 25 May at Hamilton Place. All are welcome. If you are keen to join the committee you are invited to contact the Group through the Society's conference office (+44 (0)20 7670 4345 conference@aerosociety.com). The AGM will be followed by The Ann Welch lecture given by Steve Pozerskis, Registered Valuer, Bruton Knowles.



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Avalon 2017 smashes records

JEFF LOCK reports on the thunder down under at this year's Australian Aerospace and Defence Exhibition at Avalon, held on 28 February - 5 March.

A USAF F-22 thrilled spectators in the flying display.



Airshow 2017 delivered a record crowd. Total attendances over the six days were 210,664, breaking the previous record, set in 2001, by more than 9,000. Total public day attendances were 176,742 and the industry-only trade days had 33,922 attendances, again a record. Airshow CEO Ian Honnery said total crowd numbers were up more than 20% on the 2015 event.

Honnery continued: "There were many factors that contributed to this outstanding result," he said. "We were blessed with perfect weather and had a great array of aircraft, including the two Joint Strike Fighters which were making their Australian debut. I thank our patrons, exhibitors and stakeholders for contributing to this brilliant outcome."

The Airshow's associated trade show, the Aerospace and Defence Exhibition, was also highly successful. It attracted a record 664 participating exhibitor companies from Australia and 25 overseas countries. Companies exhibiting at the event were exposed to more than \$24bn worth of business opportunities. The event also attracted 158 Australian and foreign delegations, including 79

domestic and 79 international (from 45 countries).

"We have established ourselves as the premier aviation, aerospace and defence trade event in Australia and the Asia Indo-Pacific region," Honnery said. "We have become an important driver of Australia's aerospace and defence sector and provided a shop window for local technology innovators and, as such, we brought the world to Australia and took Australia to the world."

Honnery thanked the Airshow major stakeholders. "The support of the Royal Australian Air Force (RAAF), the State Government of Victoria and the City of Greater Geelong is vital to our ongoing success," he said. "They play a key role and without them the Airshow would not exist."

Total aircraft attendances were 634, of which 328 were participating aircraft on display. There were 108 military aircraft taking part from eight nations. Of these, 61 were from the RAAF and 12 from the USAF. "The RAAF brought a record number of aircraft to this Airshow," Honnery said. "We are also appreciative of the involvement of the USAF which has been a long time supporter of ours."



Avalon 2017 witnessed brilliant flying displays featuring a cavalcade of military heavy metal, including the two F-35s, F-22 Raptor, Super Hornets, F-16s, Hawks, the giant C-17A Globemaster III, swarms of attack helicopters, and vintage aircraft (Lockheed C-121C Super Constellation and warbirds) re-living their glory days. The unmanned aerial vehicles were well represented in the 'Drone Zone' celebrating all (aviation) things remotely controlled.

RAAF F-35s roar in

On Friday 3 March, 2017 VIPs, including Prime Minister Malcolm Turnbull, Defence Minister Marise Payne, Defence Industry Minister Christopher Pyne and Lockheed Martin CEO Marillyn Hewson, welcomed the F-35s to Australia. The two F-35As are currently based at Luke Air Force Base in the US but were flown to Australia for the first time by RAAF pilots on the Monday. Their debut in Australia comes 15 years after the Federal Government first announced Australia would participate in the 'system development and demonstration phase' of the US-led Lockheed Martin Joint Strike Fighter programme.

PM Turnbull paid tribute to Australian defence technology used to build the Lightning IIs. To date Australian companies have received over \$800m worth of F-35 contracts and defence estimates that Australian industry participation in production of the some 3,100 F-35s on order today will reach over \$2bn by 2023 with further opportunities beyond that date.

Australian companies participating in the F-35 project are A W Bell (Victoria), Marand (Victoria), Quickstep (NSW), Levett Engineering (SA), Lovitt

Technologies (Victoria), and Heat Treatment Australia (Qld, NSW, Victoria).

The PM continued: "It is an example of how our defence industry plan is not simply securing our Air Force and our Army and our Navy with the capabilities they need to keep us safe in the 21st century but it is driving the advanced manufacturing, the jobs, the advanced technology that Australians need to make sure our children and grandchildren have the opportunities in the years ahead."

Defence Minister Marise Payne said the F-35s (referred to as Gen 5 capability) were: "Game-changing" for the RAAF. "They will provide the air force with the ability to execute air combat missions which were previously beyond our scope. In fact, not too long ago, previously beyond our imagination," she said. "The F-35 has stealth built into it, right from the start. Its fuel tanks, its weapons and sensors are on the inside of the aircraft. They can share information with other aircraft, including the Army, the Navy and those of our allies and coalition partners."

Accounting firm PricewaterhouseCoopers has examined the economic impact of the jet's production and maintenance programme and predicts the number of jobs generated in Australia by the F-35 will double to 5,000 by 2023.

The Government is preparing to spend \$17bn on 72 F-35 aircraft, with the first expected to be delivered to Australia in 2018 and enter service in 2020. During the airshow the head of the US-led JSF program, Lieutenant General Chris Bogdan, said Australia could eventually expect to pay under \$A106m for each F-35, as the cost of the aircraft continues to fall. As a comparison the cost of a current F16 fighter (Gen 4 capability) is approximately \$A80m.



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● SHOW REPORT

Avalon 2017



Historic route draws echoes

The trans-Pacific flight of the two RAAF F-35 aircraft to Australia marked several firsts, including the first time the Lightning II has operated in the southern hemisphere. Piloted by Sqn Ldrs Andrew Jackson and David Bell – Australia's first qualified F-35 pilots – the two F-35s transited a distance of more than 16,000km (8,000nm) from their current home at Luke AFB outside of Phoenix, Arizona, to RAAF Base Amberley in Brisbane.

The return flight of the F-35s to the US also has great historical significance, replicating the 1934 flight of Australian aviation pioneer Sir Charles Kingsford Smith, who flew his single engine Lockheed Model 8D Altair aircraft, named *Lady*

Southern Cross, on the first ever west-to-east aerial crossing of the Pacific Ocean.

The F-35, with its array of on-board sensors, supersonic performance and designed-in stealth technology, represents a formidable advance in aviation capability beyond the wildest dreams of Kingsford Smith. One notable coincidence, though, is that both the Lockheed Altair and F-35 are powered by Pratt & Whitney engines. However, the F135 engine on the F-35A generates more than 100 times the power of the Altair's Wasp nine-cylinder radial piston engine. The F-35s transit from Australia to the US was completed in less than three days and a total flying time of approximately 20 hours.

The F-35s were refuelled in-flight by RAAF KC-30 tanker crews and made overnight stops at Andersen AFB on Guam and Hickam AFB, Honolulu, Hawaii, before completing the transit to Luke AFB, Arizona, on 10 March.

In comparison with the smooth transit for the F-35s, flying over 30,000ft at an average speed of 450kt, the trans-Pacific crossing by the Lockheed Altair *Lady Southern Cross* was significantly more arduous, with a flight time of 52 hours, at an altitude of no more than 15,000ft and an average speed of 150kt. The F-35 is a worthy inheritor of Kingsford Smith's legacy and continues the more than 80-year ties between Lockheed Martin aircraft, Pratt & Whitney engines and aviation in Australia.



Growler makes Avalon debut

As well as the F-35, another sign of future Australian air power was two RAAF Boeing EA-18G Growlers which made their first appearance at Avalon. The RAAF is set to receive 12 of the electronic warfare aircraft.

RAeS Australian Division at Avalon

Avalon 2017 is two concurrent events – an exhibition and trade show (Tuesday to Friday lunch time) followed by a public airshow (Friday afternoon and evening, Saturday, and Sunday). The Australian Division accepted an invitation from Avalon 2017 (Aerospace Australia Ltd) to participate fully. The Melbourne Branch took on this responsibility to manage the presence at Avalon 2017 and was supported by members from Sydney and Canberra Branches. During the airshow the display was visited by many senior aerospace professionals, including the RAeS President Prof Chris Atkin, accompanied by our Australian Division President, John Vincent. The presentation of our display was changed dramatically for the public days when our Canberra Branch presented 'Cool Aeronautics'. As background, Cool Aeronautics was first launched in Australia in 2009 and is based on the very successful programme established in the UK named Cool Aeronautics – which is the RAeS STEM outreach programme that aims to introduce school children (particularly primary age) and the public to the fascinating world and people of flying, aerospace engineering and space. In particular, Cool Aeronautics embodies the Society's aim to 'promote aerospace and aviation to a new generation'. Canberra Branch representatives Assoc Prof Andrew Neely (who is also the new Australian Division President) and Sqn Ldr Evan Smith re-arranged our stand with over 50 model aircraft, and other aeronautical equipment which caught the public's attention, particularly families with children. Andrew and Evan were basically mobbed for the two and half days, as shown in the photos.



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Bell rings the changes in Valencia



TERRY SPRUCE reports on the opening of the new Bell Helicopter Training Academy Valencia centre.

On 14 February Bell Helicopter Training Academy Valencia hosted a grand opening of its new training centre. A partnership between Bell Helicopter and sister Textron company,

TRU Simulation and Training, the new centre was given approval by the European Aviation Safety Association (EASA) in January.

The training classes at BTA-Valencia will use an Odyssey H Bell 429 EASA-certified Level D Full Flight Simulator (FFS). BTA-Valencia offers two courses, a ten-day Bell 429 EASA initial type rating and a three-day Bell 429 recurrent course to reinforce the initial type rating. Additionally, BTA-Valencia will offer wet and dry leasing custom-tailored to each operator. The Academy also plans to add additional courses in the coming years.

2017 – A simulator odyssey

The new simulator centre is housed in the Cessna Citation facility at Valencia Airport. The new

simulator is the first Odyssey H Bell 429 FFS to be built by TRU Simulation, a company formed just over two and half years ago from AAI in Goose Creek, South Carolina; Mechtronix in Montreal;

Opinicus in Lutz, Florida, and ProFlight in Carlsbad, California. The EASA Level D certified Bell 429 FFS offers what is claimed to be the largest standard visual field of view (240 degrees of vision), as well as the largest dome radius of any simulator on the market today. The simulator features high-fidelity accelerations, smoothness, and responsiveness powered by REALFEEL

Control Loading System and REALVibe Secondary Cueing System. The FFS also has a second motion sensor set in the floor of the simulator which gives the occupants the feeling of real flying.

I was the first aviation journalist to fly the simulator along with one of the instructors. Using the simulator, we were able to go through all the scenarios that pilots will encounter, including one engine out, one flight controller out and beyond safe engine limits – during which the simulator



Above: Inside the TRU Simulation + Training Odyssey H Bell 429 full flight simulator (FFS) built by TRU Simulation and the actual Bell 429 helicopter it is based upon.

TRU Simulation and Training and Bell Helicopter are both Textron companies.



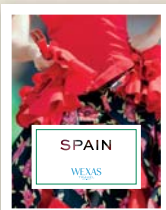
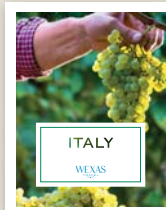
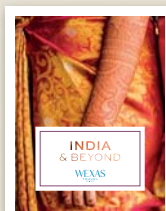
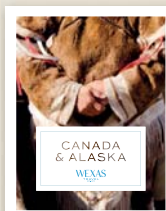
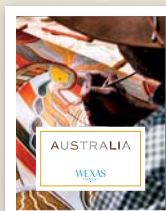
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● ROTORCRAFT

Training

gave a very realistic noise and vibration of a rough engine. The simulator has also been designed to allow training on different helicopter modules. TRU Simulation currently has an order from CopterSafety for three simulators with five different helicopter modules.

The simulation hangar is already preparing for a second simulator which, dependant on the market, might well be a fixed-wing business aircraft. Dave Smith, VP Training Centres, confirmed that TRU is open to developing where the market takes them, with either rotorcraft or a fixed-wing simulator.

He added that locating the facility at Valencia was an easy choice, as Textron is already here with the Cessna Citation Service Centre and all the infrastructure needed is *in situ*.

Growing market

In a joint briefing before the opening ceremony, Bell Helicopter and TRU Simulation explained why the first simulator is a Bell 429 and the reason that the facility is in Spain. The market in Europe for the Bell 429 is strong with a number of large orders from government-based agencies, including the Swedish Police which operate seven examples from five bases. Thomas Lindall, Flight Operations Manager



THE FFS ALSO HAS A SECOND MOTION SENSOR SET IN THE FLOOR OF THE SIMULATOR WHICH GIVES THE OCCUPANTS THE FEELING OF REAL FLYING

growing interest in the VVIP market and he expects growth in that area of the market – confirming what was said by VIP helicopter operators at the Heliinvestor Conference in London earlier in the year.

Glenn Isbell, at Bell Helicopter added: “I say with great pride that we have trained more than 140,000 students from 135 different countries throughout the world and today we are expanding that reach. Bell Training Academy Valencia enables us to serve the training needs of our European, Middle Eastern and other customers around the world. Our training experience is further enhanced by the world-class instructors who bring more than 5,000 hours of training experience across multiple platforms, as well as English, French, Spanish and Italian capabilities to the local facility. Safety is a key priority for Bell Helicopter and there is nothing that affects aircraft safety more than preparing pilots with the most reliable and comprehensive training that exists.”

TRU Support

Ian Walsh from TRU Simulation said that he had a lot to celebrate. “As a former helicopter pilot in the military I know first-hand the challenges



for the Swedish Police explained their operations and how two of its Bell 429s are used for mountain rescue in the north of Sweden and are fitted with hoists. The Swedish Police fleet has flown some 6,000hrs since the aircraft were delivered in late 2015.

Jakub Hoda, Managing Director for Europe and Russia, explained how the helicopter market is becoming stronger despite the woes in the oil and gas industry. He confirmed that there had been

Above left: Odyssey H Bell 429 EASA-certified Level D Full Flight Simulator (FFS).

Above right: The TRU Simulation training centre in Valencia, Spain.

that rotorcraft pilots face and I am proud of the innovation of the Bell 429 full flight simulator brings to pilots,” he said. “Since launching in 2014, expansion has been a key theme for TRU in becoming a total training solution. Beginning with the establishment of TRU's East and West coast pilot training centres in North America which support Textron Aviation platforms, we now begin an international journey to expand our reach a little bit further.”

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Royal Aeronautical Society
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Minding the challenges of mental health



The reverberations of the 2015 Germanwings tragedy continue to echo through the civil aerospace sector as Regulators, AOC holders and other stakeholder groups address the implications of that event. **MARC ATHERTON** looks at the regulatory and implementation challenges facing our industry in advance of the 2017 Aircrew Mental Health Conference.

Regulators and AOC holders have responded to the challenges posed by the fall-out by acknowledging the need to have a Peer Support System in place as part of the safety management systems required for all operators.

A Peer Support System provides a mechanism whereby a pilot can access a confidential helpline and obtain support from a trained (pilot) peer in addressing any mental health related issues that the individual has.

AOC holders and pilot organisations will already have internal systems that meet this need for issues around alcohol and substance problem, some of which have been expanded to include mental health issues (c.f. BA PAN programme, Dutch ..., German

Stiftung Mayday/AntiSkid). The PSS initiative provides a requirement and a framework which is specifically targeted on providing a secure and effective means of support for aircrew facing mental health challenges such as anxiety, depression or stress related symptoms.

There are of course several challenges in implementing a PSS in an operational airline. These challenges include issues around process and content (how is the system accessed? Is the system voluntary or can individuals be referred? what levels of confidentiality are incorporated? what level of training is appropriate for individual Peer Support individuals? What are the boundary limits for the PSS intervention? What procedures exist for further referral beyond the PSS if appropriate?)



International Rescue

Humanitarian operations, be they short or long-term, localised or global, incorporate the use of military and civilian aerospace assets to deliver much-needed aid. **MIKE BRATBY**, reports from a RAeS Conference on the subject.

Today there are more people in need of humanitarian aid than at any time since WW2. Governments, along with international organisations and NGOs, are all struggling to support the growing need as the funding gap between what is needed and what is available continues to grow. Whenever a disaster occurs, the aviation sector possesses a unique ability to transport aid cargo and responders quickly to areas of need. As such there is a growing need for collaboration on a regional and international basis and recent organisational and technological developments can combine with air assets to act as a force multiplier of considerable effect.

The RAeS Air Power Group hosted a one-day conference on 16 February 2017 to explore these issues. The event was sponsored by CargoLogicAir and Boeing and included presentations by the

Department for International Development, Oxfam, Chief of Flight Operations ICAO, senior MoD (UK) and RAF commanders and the CEO of Rescue Global plus a series of equipment capability presentations. There were also morning and afternoon panel sessions to discuss the key points and case studies raised.

Department for International Development

The Department for International Development (DFID) remains the UK's primary humanitarian response agency; it accounts for much of the £1.2bn aid funds spent each year. It leads work to eliminate extreme poverty and tackles global issues such as mass migration, epidemics and conflict, aiming to build a better, healthier world for the benefit of

Below: HMS Daring's Lynx helicopter delivers humanitarian relief supplies to Binuluan in the Philippines in 2013.

Below opposite page: A view of thousands of internally displaced people at Bangui's airport, Central African Republic (CAR), from a UNHCR aircraft.



developing countries and the UK. Its policy priorities include building a bigger, faster response to crises and shifting its approach to deal with protracted situations in addition to short-term relief.

The Department aims to make its current systems more efficient with better leadership and joint planning and response. Response strategies presently cover direct provision of aid, specialist expertise, diplomacy, advocacy and influencing, all important political aspects helping to smooth the progress of humanitarian aid operations worldwide. Stockpiles of food, shelters and other supplies are held at five airport storage locations, three of them overseas. To move the aid, freight forwarders and air brokers are utilised. A memorandum of understanding with the MoD (UK) enables use of air and surface means and civil and military assets. There is an emphasis on air-ground interfaces, recognising that airheads can become a bottleneck if ground handling and onward delivery are not matched with the air delivery tempo.

Case study Nepal

The 2015 earthquake in Nepal saw a mix of air and surface transport used to rush supplies to the stricken country. Both military and civil airlifters were employed. UK agencies were coordinated by DFID which was responsible for moving 228 passengers by air, 1,151 tons of aid by ground transport, 184 tons of civil air cargo and 50 tons by RAF airlifters. Civil and military cargo costs were similar but commercial options offered higher payload per route. Overall, it was a highly successful operation, with DFID carrying out contingency planning, funding World Food Programme (WFP) to establish a humanitarian staging area funding stocks of emergency shelters and purchasing airfield support equipment. It demonstrated how interfaces between the agencies can work in practice; there were initial problems with access to the affected area but this was later resolved.

ICAO/UN

UN air operations have played a major part in establishing aviation as the main mode of delivering



urgent relief supplies. As the world's commerce and air traffic continue to grow exponentially, the UN is becoming more proactive and predictive, moving from disaster relief to risk reduction. For example, a co-ordination team was rushed to the site of the nuclear disaster in Japan immediately the situation developed and a UAV employed for vital surveillance from an early stage in the emergency.

Operations include the UN Humanitarian Air Service and Department of Field Support to support peacekeeping and special political missions. Field Support teams have been heavily engaged with attempts at conflict resolution in the Middle East and Africa. To give some idea of the scope of UN aviation operations, the UN's WFP in 2015 deployed over 70 aircraft, delivered 62,500 metric tons of air cargo, carried over 287,000 passengers and made airdrops to starving people in Yemen and South Sudan, the only civil operator to deliver aid by air dropping.

Oxfam

Oxfam is representative of NGOs playing a growing part in disaster relief. Its network of outlets around the world enabled support for 25m beneficiaries in 2014/15. Recent projects include providing clean water and sanitation in different countries. The organisation maintains a programme supply chain for £250m per annum. However, the principle is to spend locally wherever possible, rather than to deliver from overseas.

However, air assets play a major part. They enable rapid mobilisation of staff and deployment of materials and quick access to the affected area. Oxfam utilises partnering with BA, special tariffs and free transport and dedicated services such as UN HAS. Co-ordination and interfaces with other agencies are essential and collaboration and partnerships need to be initiated well ahead of urgent requirements. To achieve this, Oxfam organises for long-term commitments and seeks to overcome constraints such as lack of local facilities, availability of air assets, expertise and cost.



TO GIVE SOME IDEA OF THE SCOPE OF UN AVIATION OPERATIONS, THE UN'S WFP IN 2015 DEPLOYED OVER 70 AIRCRAFT, DELIVERED 62,500 METRIC TONS OF AIR CARGO CARRIED OVER 287,000 PASSENGERS

● AEROSPACE

Humanitarian relief and air power



Airlink

Airlink is representative of the growing number of interface organisations set up to provide a civil response to disaster relief. A rapid response non-profit organisation, it links airlines with NGOs to airlift personnel and relief supplies to disaster areas. So far it has 70 NGO partners, has utilised 35 airlines, moved over a million tons of air cargo and supported 400 aid missions. It has played a major part in the Ebola air bridge to Africa and in the response to Hurricane Matthew in Haiti. In the latter case it supported two million people with food aid, water, medicines and services. There is seen to be a growing need for support agencies such as Airlink. They increasingly provide the practical interfaces.

CargoLogicAir

CargoLogicAir is illustrative of the resources available to the civil sector for humanitarian aid airlifts. The group provides solutions, often at short notice, for a range of logistical problems and challenges to airlift cargo and personnel for commercial and humanitarian missions. It works closely with the Red Cross and has delivered aid, personnel and vehicles to 18 humanitarian and Red Cross missions since 2001. CargoLogicAir operates from Stansted Airport with a fleet of three B747 cargo aircraft. It has 100 staff, 75 of them aircrew. The 747s are able to accommodate oversize loads and vehicles for humanitarian relief missions.

Above: As part of its expanded end-to-end air transportation solution to Hurricane Matthew, Airlink sent two large charter flights, packed with medical supplies, to Haiti in 2016.

Below: CargoLogicAir (CLA) Boeing 747, the new British all-cargo airline headquartered at London's Stansted Airport.



BOEING UK'S DEPUTY CHIEF TEST PILOT PROVIDED A PERSONAL ACCOUNT OF THE DELIVERY OF AID BY RAF CHINOOK HELICOPTERS TO THE SITE OF THE PAKISTAN EARTHQUAKE IN 2005



The closely-associated Volga-Dnepr operates IL 76 and AN-124 airlifters based in central Europe, the former able to carry up to 50tons, while the AN-124's payload is up to 150tons, enabling it to transport heavy vehicles and even cranes. A key factor in using these assets is their low reliance on host nation infrastructure and ground handling. Between 1992 and 2015 the airline delivered 28,000tons of relief supplies to humanitarian crisis areas. However, giant airlifters do not come cheap. The fleet is currently ageing and major, expensive upgrades are planned to enable all their aircraft to meet future ICAO noise and emissions limits, enabling them to continue operations worldwide. Volga-Dnepr also provides the Strategic Airlift Interim Solution for NATO, chartering AN-124 aircraft to the Alliance from their base in central Europe for humanitarian and peacekeeping tasks. They have been in much demand for supporting coalition operations in Afghanistan.

Military response – MoD and RAF

On the other side of the equation, the UK military response to humanitarian need was identified in *SDSR 15* as one of the eight defined missions for UK armed forces. Joint Force HQ is the Defence lead for crisis response. DFID requests a military response when a civilian reaction is not available, the scale of crisis is overwhelming, or the military can provide the most effective response. Political and media factors may also play an important role – the impetus of 'something must be done' and the favourable image of RAF airlifters and helicopters delivering aid should not be underestimated. The Standing JFHQ Group provides training of quick reaction teams along with crisis response, early entry, and networking with other agencies, which may be needed to provide facilities and equipment, and joint force exercises. However, intervention in a crisis will ultimately depend upon constraints, other commitments, political judgements and the art of the possible.

The full range of RAF air power and air capabilities may be required to support humanitarian operations, as was the case with NATO and UK intervention in the Balkan crisis in the 1990s. Control of the air, ISR, which may include UAVs for surveillance and attack missions, air mobility and SH may all be involved. An Air Contingency Planning Group leads the planning process. Involvement in a particular operation will naturally depend on availability of assets and constraints such as the impact of re-tasking, costs and force protection. Location, duration, aid requirement and effect will also be considerations, as will pragmatic decisions on whether to commit the best-suited asset or the first available. Again, political considerations are likely to be weighed along with the other factors.

Future challenges are likely to include the declining number of airlifters available, especially



with the phase out of C-130s, the requirement to keep pace with technical advances in systems and the ongoing need to sustain other operational commitments. As indicated, networking and interfacing between aid agencies and organisations will often be required to help facilitate aid operations.

Changing landscape of tactical delivery of aid

Boeing UK's Deputy Chief Test Pilot provided a personal account of the delivery of aid by RAF Chinook helicopters to the site of the Pakistani earthquake in 2005. The UK pledged £33m aid and funded a military operation for 28 days. The aircraft faced serious problems with access, given the high, mountainous terrain. 117 helicopters belonging to different operators were involved. All operated from a Pakistani military airfield. The UK's three Chinooks delivered a very creditable 1,447 tons of aid. It was found that a logistics chain for delivering aircraft spares was essential. As a result of this and other recent emergency airlifts, the landscape of tactical air delivery is changing. The problem of difficult access is being addressed with the development of high-altitude precision air drops. Communications are being improved, while RPAS ranging from small short-range drones to highly sophisticated platforms such as Global Hawk are increasingly being employed for intelligence collection and security. Additionally, the Avenger UAV has recently demonstrated its ability to drop up to 8,000lb of aid from its internal bay. The V-22 Osprey tiltrotor aircraft may also be employed where terrain and access prove difficult. Other lessons have been learned, or re-learned in recent operations, including the need for early reconnaissance, security of the operational base, availability of handling equipment and dedicated PR.

For the future, the Airlander Hybrid Air Vehicle (HAV) possibly points the way, with its advanced composite construction, five-day endurance, ability

Above: A 99 Squadron C-17 transport aircraft at Cebu Airport in the Philippines following the devastation wreaked by Typhoon Haiyan in November 2013.

The flight was organised to support the Department for International Development and carried vital supplies, such as JCBs, Landrovers and pallets of medical supplies.

Right: RAF personnel unload humanitarian aid to Pakistan from a C-130 Hercules aircraft, following devastating floods in the country in 2010.

to lift heavy loads without infrastructure needs, and low cost of operation and flexibility. It could be employed for surveillance and security of a humanitarian operation, or the precision delivery of large amounts of aid. Once the current flight test programme is completed, production Airlanders could be available from 2019.



Conclusion

The conference was titled the Civil/Military Interface. In fact this proved a misnomer, for the presentations and discussion revealed that recent and ongoing humanitarian crises often generate a sizeable aid effort which, in turn, produces multiple interfaces between the various agencies. These will often be *ad hoc* but, with formal agreements following as governments, commercial operators and NGOs work out *modus operandi* between them to resolve problems. Above all, the solutions are usually driven by a combination of humanitarian, political and organisational factors and the art of what is possible. The introduction of new technologies, such as HAVs, tiltrotors and UAVs, are likely to extend and strengthen the capabilities of the various players in terms of their contributions to humanitarian crises, with networks and interfaces continuing to play a growing role in getting the aid to where it is needed in a timely fashion.



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Established as a key event in the social calendar of the aviation and aerospace community, the Royal Aeronautical Society Annual Banquet attracts high level industry attendance and offers the ideal opportunity for networking and corporate entertainment.

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Sir Martin Sweeting OBE FRS FREng FIET HonFRAeS
Group Executive Chairman, Surrey Satellite
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The InterContinental London Park Lane,
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Programme

Reception: 7.15pm Dinner: 8.00pm

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Afterburner

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Diary

16 May

Seattle Branch

Introduction to the KC-46 tanker design

Danny Wright, KC-46 Chief Mechanic, Boeing



A Boeing KC-46A Pegasus refuels a US Navy F/A-18. Boeing.

42 Message from RAeS

- President

"By the time you read this, I shall be well on my way through the revolving door at 4HP (that was figurative, for those of you trying to picture this new door), with the 2017 Branches Conference pretty much the last item on my agenda before the AGM."

- Chief Executive

"This month Prof Chris Atkin CEng FRAeS concludes his Presidential year and we welcome Air Chief Marshal Sir Stephen Dalton FRAeS as his successor. Chris has been a very active President representing the Society at many events and also visiting all our Divisions."

44 Book Reviews

Wings of Empire, Bloody Paralyser and American Aircraft Development of WWII.

47 Bristol Scout documentary

A new documentary *Bristol Scout – Rebuilding History* was premiered at Leicester Square's Prince Charles Cinema which relates the remarkable story of the reconstruction of a 1915 Bristol Scout Type C No1264, starting from the original stick and rudder bar.

48 Balloon Challenge

The Boscombe Down Branch organised a Balloon Challenge; a STEM outreach project for children of secondary school age.

50 New Corporate Partners

Seven new companies join the Society's Corporate Partner Scheme.

52 Diary

Find out when and where around the world the latest aeronautical and aerospace lectures and events are happening.

54 Australian Division

John Corby, an Australian aircraft designer, has won the 2017 Lawrence Hargrave Award for the full design and build of the Starlet light aircraft.

55 YPN in the spotlight

An update from the Young Persons Network.



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OUR PRESIDENT

Prof Chris Atkin



WHAT HAS BEEN THE HIGHLIGHT OF MY YEAR? UNDOUBTEDLY THE DEDICATION OF OUR MEMBERSHIP, PARTICULARLY THE BRANCH COMMITTEE AND DIVISION COUNCIL MEMBERS I HAVE BEEN PRIVILEGED TO MEET ALL AROUND THE WORLD

By the time you read this, I shall be well on my way through the revolving door at 4HP (that was figurative, for those of you trying to picture this new door), with the 2017 Branches Conference pretty much the last item on my agenda before the AGM. The Conference presents a real opportunity to mull over the successes of the 2016 sesquicentenary and to build on the momentum created during that remarkable year. We should also consider how we can increase the opportunities for our younger members to get involved in branch activities.

What has been the highlight of my year? Undoubtedly the dedication of our membership, particularly the Branch Committee and Division Council members I have been privileged to meet all around the world. In February, while speaking at the 2017 Australian International Aerospace Congress, I was introduced to the delegates as 'President of the RAeS of the UK' and somewhat doggedly muttered (or so I thought) 'not just in the UK', whereupon the conference chair returned to the microphone and said, "actually, President of the RAeS in the whole world!" As you might expect, the gathered Aussies then greeted me as "President of the Whole World" for the next few days. I can say that I have enjoyed my stint as global leader and make no apology for repeatedly pointing out that we work in a global enterprise and should set our aspirations for the Society accordingly – which includes working towards a President in the future who is not based in the UK.

It may sound odd, but I have been reassured that, across the world, the RAeS is more or less facing the same challenges, principally to enthuse the new generation of aerospace professionals with what the Society has to offer. I know that Sir



Chris Atkin, RAeS President, speaks to the 3AF at its Applied Aerodynamics conference in March.

Stephen Dalton will make this a big focus of his presidential year. I can only repeat my message from the March issue of *AEROSPACE*, that the Society's most attractive offering is an active membership, and that we must focus upon increasing the opportunities for members to pursue their own ideas and develop their professional aspirations through the Society. For me, 2016 afforded an opportunity to learn from the founders of the Society and, in particular, Lord Kelvin's spectacular rejection of the invitation to shape the future of 'aerial navigation'. Our founding members were frustrated at the status quo; they wanted to realise what they saw as unfulfilled potential; their enthusiasm and ambitions were seen as misdirected by their peers, but they got on with it anyway. Isn't this exactly what the Royal Aeronautical Society needs to be for today's young professionals?

Reminder

152nd Annual General Meeting of the Royal Aeronautical Society

The 152nd Annual General Meeting of the Royal Aeronautical Society incorporating the Institution of Aeronautical Engineers, the Helicopter Association of Great Britain and the Society of Licensed Aircraft Engineers and Technologists will be held on **Thursday, 11 May 2017, at 1800 hours** at the Registered office of the Society, No.4 Hamilton Place, London W1J 7BQ, UK.

The Royal Aeronautical Society Annual Review and Summary Accounts and the Annual Report and Accounts are available to view via www.aerosociety.com/agm along with the draft minutes from the 151st Annual General Meeting.

To register your attendance to the 152nd AGM please visit our website on: www.aerosociety.com/events-calendar/raes-annual-general-meeting

OUR CHIEF EXECUTIVE

Simon C Luxmoore



“

CHRIS HAS BEEN A VERY ACTIVE PRESIDENT REPRESENTING THE SOCIETY AT MANY EVENTS AND ALSO VISITING ALL OUR DIVISIONS

- This month Prof Chris Atkin CEng FRAeS concludes his Presidential year and we welcome Air Chief Marshal Sir Stephen Dalton FRAeS as his successor. Chris has been a very active President representing the Society at many events and also visiting all our Divisions. Chris has been instrumental in building upon the Society's strategy through the work carried out by the International Strategy Working Group and the Membership Review which we will see being implemented this year. We thank Chris for all his hard work and wish him and his wife Siobhan best wishes for the future, especially as Chris takes up his role as Chairman of the Engineering Council.
- We are delighted that, alongside continuing support from AlixPartners, Sir Martin Sweeting HonFRAeS, Group Executive Chairman, Surrey Satellite Technology Ltd (SSTL), will be our Guest of Honour at this year's Annual Banquet. I look forward to meeting again with many of our members, Fellows and Corporate Partners at this wonderful networking event on 11 May.
- Since the start of the year, the Government has been very active in the aerospace and aviation sector, publishing a number of long-expected policy consultations and legislative initiatives. Parliamentary Select Committees have been launching parallel inquiries on the same issues. The Society has been providing membership-led responses to all relevant consultations and inquiries. Society expert input so far has been to i) Department for Transport consultations on the safe use of drones, and night flight restrictions at Heathrow, Gatwick and Stansted airports, ii) House of Commons Transport Committee inquiries into airspace management and modernisation and the Government's Draft Airports National Policy Statement (NPS), as

well as iii) a House of Commons Science and Technology Committee inquiry into The Draft Spaceflight Bill. Finally, through the Engineering the Future alliance of professional engineering institutions, the Society is responding to the Department for Business Industrial Strategy 'Green Paper' consultation.

- The Society has agreed an exciting partnership with the Advanced Manufacturing Research Centre (AMRC) to deliver bespoke Continuing Professional Development training courses for members covering aerospace materials and aerospace manufacturing processes. This is one of the many ways we continue to explore new member benefits and offer enhanced opportunities for continuing professional development.
- The staff have been busy testing and progressing an upgrade of our membership database system, as well as the online member portal which allows potential and existing members to join the Society, upgrade your membership and register for events online. There will be a period between the middle and end of May when online services may be affected or unavailable for use as we roll out the update, so we thank you in advance for your patience. If you require any assistance during this time, please call the Headquarters on +44 (0)20 7670 4300 or email raes@aerosociety.com.
- The Society's UAS group held another successful seminar in March, looking at a risk-based approach to RPAS operations with a series of 'TED' type talks offering five-minute talks on practical-based solutions. We look forward to their next seminar on Safely Enabling Unmanned Aerial System Traffic Management on 16 May.

2017 RAeS COUNCIL ELECTIONS

HAVE YOU VOTED IN THE RAeS COUNCIL ELECTION 2017 YET?

Thank you for taking the time to vote in the 2017 RAeS Council Elections

The Royal Aeronautical Society Council Election 2017 opened for voting on 23 February 2017. All voting members who have an email address registered with the Society will have received an email notice enabling you to vote. If you believe that you are a voting member but did not receive an email, or you do not have a valid email address registered with the Society, then please contact

our election provider, mi-voice, on +44 (0)2380 763987 (we would advise you check your email account's junk folder, in case your email settings determine this email as being spam).

Please note that voting will close at 9am on Thursday, 11 May 2017.

WINGS OF EMPIRE

The Forgotten Wars of the Royal Air Force, 1919-1939

By B Renfrew

The History Press, The Mill, Brimscombe Port, Stroud, Gloucestershire GL5 2QG, UK. 2015. 320pp. Illustrated. £25. ISBN 978-0-7509-6507-1.

Wings of Empire has proved a difficult book to review. For a general audience it is one book: for those with a background in aviation it is another. The dustjacket note states that "For the first time ever, this book chronicles the full story of the RAF's most extraordinary conflict" and, in terms of objectives, this is all the reviewer has to work from. Anyone with an appreciation of British aviation history will know that this is not the 'first time ever' that the work of the RAF in colonial policing has been told. Then, having read the book, it is apparent that it doesn't quite embrace the full story of the RAF in action between the two World Wars.

For the general reader coming to the area fresh *Wings of Empire* is a highly readable exploration of that period between the two World Wars when the RAF was struggling for survival. It became involved in various operations, either on its own account or in support of the Army, across Africa and Asia and, most extensively, in Mesopotamia and the North-West Frontier between India and Afghanistan.

Barry Renfrew is by profession a foreign correspondent who has researched his subject in some detail and the book is referenced throughout. The writing is vivid and includes many invaluable extracts from diaries and personal records held by the Imperial War Museum. These convey a fine sense of life in the RAF policing colonies, mandated territories and India and are helpful in bringing the story to life. They put flesh on the bare bones and highlight the hardships of working in lands where climate and disease combined to make life miserable. For the reader looking for a primer on the inter-war conflicts involving the RAF this book is as good as any.

The thrust of the book is that the RAF, both on its own account and at the behest of politicians and administrators, ruthlessly and often needlessly killed native peoples who had offended government and destroyed their homes and livestock. The offences might range from withholding taxes to wholesale slaughter, such as that inflicted on Iraqi Arabs by Wahabis from the Nejd (not Nejl)

It is certainly the case that there were excesses in attacking indigenous people and, even by contemporaneous standards, the use of delayed-action bombs against villages appears unforgivable. Mesopotamia (later Iraq) and Transjordan were mandated territories and the



Above and right: Vickers Valentia, K4632, was modified for sky-shouting to marauding Iraqi tribes during air police duties. The installation incorporated four loudspeakers and weighed 1,430lb. RAeS (NAL).

For the general reader coming to the area fresh *Wings of Empire* is a highly readable exploration of that period between the two World Wars when the RAF was struggling for survival

responsibilities attaching to governance complicated options for action against revolt but this important characteristic is overlooked. There was some dissent and three pages are devoted to the insider critic, Air Cdre L E O Charlton. There is no reference to rules of engagement but the evidence is that they existed by 1923 and were applied. There is balance to the near-endless descriptions of bombing with a fine chapter on the Kabul evacuation.

Turning to that potential readership with a background in aviation, *Wings of Empire* remains readable with many gems. The book covers many but by no means all, of the inter-war years' actions undertaken by the RAF. For a formal history it is let down by unnecessary hyperbole and repetitive adjectives sprayed through the text like those machine-gun bullets aimed at natives described with such relish throughout. Further, the general tone conveys the impression that the author has sensed a story and then incorporated material that appear to support his case. Where David Omissi's formal analysis (*Air Power and Colonial Control* (Manchester University Press. 1990) brought a degree of objectivity to the topic of air control, Renfrew sensationalises it.

In the prologue we read that: "This book is not an attack on the men who tried to rule the empire from the sky. Air crews could be happy or heedless killers, who talked about machine-gunning a village as nonchalantly as they recounted shooting a buck... on a hunting trip." Much of the text, though, does then read as an attack. "Inspired by the possibilities of scientific warfare, some in the RAF advocated the use of poison gas, early forms of napalm and other innovations to subdue some of the most primitive people in the world." In the event gas most certainly was not used and early forms of napalm can only refer to the very occasional – and highly dangerous to the aircrew – dropping of thin-skinned four-gallon petrol cans to accelerate fires on the ground.

The story of the RAF between the world wars is not just one of endlessly bombing revolting natives. Trenchard's three pillars – the RAF College, Cranwell, the Staff College at Andover and the Technical Training School, Halton, each of which underpinned RAF performance – get no mention. The Chanak crisis gets brief mention and the part played by the RAF in supporting White Russian forces after the end of the Great War is ignored but perhaps that had little to do with protecting the Empire. The RAF and Fleet Air Arm deployments during the Abyssinian Crisis are also omitted, despite their obvious importance in protecting colonial commitments.

In the course of their various deployments RAF squadrons not only bombed recalcitrant tribesmen but contributed hugely and bravely to opening up the air routes through the Empire with far-reaching consequences. As just one example, the trans-Africa route from Egypt to the Gold Coast proved the critical Takoradi-Cairo route for the speedy delivery of aircraft to Egypt during the early years of WW2. The experience of working in trying conditions resulted in a resilience and 'can-do' approach on the part of airmen that paid dividends in the future global conflict. Their resourcefulness



was also extremely useful to the countless pioneers flying through the Middle East and India requiring assistance of every kind.

There is an extensive bibliography, a limited index but, unfortunately for a book of this type, no maps. The thoughtful collection of 53 black and white photographs deserves more than skimpy and sometimes inaccurate captions. (Gp Capt Longmore's personal DH9A is described as being AVM John Salmond's, for example.) Given that the author is not by background an aviation person, professional help with editing would have saved inconsistencies in spelling and cleared up the odd error and for this the publisher must take some responsibility. These errors include the need to clarify the trade-offs between range, speed and weapon load (of the DH9A) and also that the aircraft was fitted with a Vickers and a Lewis gun – not two of the latter. In southern Iraq John 'Pasha' Glubb got his air support from 84 Sqn at Shaibah, not Baghdad. Small mistakes, maybe but, if the basics aren't right, can the overall text be trusted?

Victor Flintham

FCIPD FRSA MRAeS

BLOODY PARALYSER

The Giant Handley Page Bombers of the First World War

By R Langham

Fonthill Media Limited, Millview House, Toadsmoor Road, Stroud GL5 2TB, UK. 2016. 208pp. Illustrated. £20. ISBN 978-1-78155-080-9.

Until recently, those looking for a book describing the Handley Page bombers of WW1 would have had to be content with Chas Bowyer's book issued by Aston Publications in 1992. Rob Langham has now put together another and, although by necessity covering the same ground, he uses a very different approach in telling the story.

There have been quite a few books and very many magazine articles over the years in which those airmen taking part in the bombing raids related their first-hand experiences. Rob Langham uses extracts from these and many other original sources to illustrate the 'Bloody Paralyser' story in their words. He explains the policies and decisions made as the War progressed and the resulting deployment and movements of the various squadrons using the Type 'O' bombers (O/100 and O/400). Into this are woven the personal accounts of aircrew, and others, giving their views and descriptions of the raids and service life. For those already well versed in 'Paralyser' history some of the names quoted will be very recognisable – Bewsher,



Handley Page O/400 in flight.
RAeS (NAL).

Monaghan and Shillinglaw, to name a few.

The book has 14 chapters, of which the first covers the pre-WW1 history of the Handley Page company (in perhaps rather more depth than necessary for a book on the bombers) and one devoted to the 'Super' Handley Page (the V/1500). Just the final two cover the peacetime operations after hostilities ceased and, earlier in the book, American manufacture and usage gets a mention. Useful technical details on the bombers, their bombs, guns and related matters appear where relevant. Interestingly there are some passing remarks about Italian Capronis, which are very much part of the overall WW1 bomber story but which hardly ever get even a comment elsewhere.

One regret by this reviewer, as for so many other books of this nature, is the lack of inclusion of any map showing where the places mentioned were located. A grouping of photographs and other interesting illustrations is in the centre of the book and includes a view of the original prototype possibly never published before. An impressive and extensive source bibliography is at the back but there is no index.

Inevitably these days there are a few printing, etc, errors and there may be some debate about one or two of the facts and dates given but, overall, it is a very readable and informative story put together by a very knowledgeable author.

This is a highly recommended book and a 'must' for Paralyser enthusiasts.

Bryan Bowen

CEng MRAeS

Review originally compiled for the *Handley Page Association Newsletter*

AMERICAN AIRCRAFT DEVELOPMENT OF WWII



Special Types 1939-1945

By B Norton

Crecy Publishing, 1a Ringway Trading Estate, Shawdownmoss Road, Manchester M22 5LH, UK. 2016. 251pp. Illustrated. £27.95. ISBN 978-0-8597-9188-5.

This book, as the subtitle suggests, describes many of the unusual and sometimes impracticable machines that emerged from across the Atlantic during WW2. It begins with a brief synopsis of the dire state of the pre-war American military aircraft industry and the need to catch up with the advanced nations as the war clouds were gathering.

The author deals with many areas of aerial warfare: photo reconnaissance, ship-launched observer planes, early VTO machines, drones, target towing, float planes, bombers modified into cargo and passenger transports and more. Some of these projects were successful, others not, with many destined for the scrap heap. He describes the attempts by the US Army and Navy to develop and employ drones in both the European and Pacific theatres. These early experiments into remotely controlled, bomb-packed B-17s, B-24s and other craft expended much cost, time and manpower. They proved to be unpredictable, dangerous and were ultimately abandoned.

The author gives fascinating and sometimes amusing examples of the occasional folly that can arise when an industry is under pressure in times of war. For example, in 1942, the US Government invited the industrialist Henry Kaiser, of 'Liberty' ship fame, to build a large trans-ocean transport. In collaboration with Howard Hughes, they dreamt up the fantasy that was the HK-1 flying boat. This eight-engine colossus weighed in at 400,000lb gross, promised a payload of 750 troops or two 32-ton Sherman tanks with an expected range of 3,500 miles. To achieve this, the wing had a root thickness

Three of the aircraft described in this book are:

Above left: Four of the five production Martin JRM-1 Mars. The Mars was originally developed as a patrol bomber but only used as a transport aircraft. These aircraft later saw extensive use as water bombers to fight forest fires. Above right: Fairchild C-82A Packet, 44-23004. The Packet flew for the first time on 10 September 1944.

Right: The second prototype Kellett XR-8, 421908, twin-rotor helicopter.

All RAeS (NAL).



of 11 feet and a span longer than a football field, although the author does not say whether the length or breadth. Funded by government grants, this monster would stand eight stories high and be made of wood! After disagreements with the government Kaiser pulled out, leaving Hughes to soldier on. Under his direction and own funding the aircraft morphed into the H-4 the famous 'Spruce Goose' – and the rest is history.

Although all the combatant nations, especially Nazi Germany, poured resources into their experimental programmes, after reading this book describing the vast expenditure of time, manpower and money, one cannot but conclude that only the US with its overwhelming technical and production capacity could afford these costly ventures without jeopardising the output of their proven war-winning machines.

This publication has its faults. The NACA was founded in 1915 not, as claimed, in 1927 and occasionally the style can be hard going, for example – p 9, col 1, line 16 "much new could be brought to the fight."

However, the book is a good factual read and is packed with photographs (some 360), drawings, cutaway diagrams and tables – data galore. It is a treasure trove of information and will appeal to those buffs who find interest in unusual machines, both successful and otherwise, including the occasional dinosaur. It is well-researched, nicely presented and is warmly recommended.

H J Murray
Affiliate

It is a treasure trove of information and will appeal to those buffs who find interest in unusual machines, both successful and otherwise, including the occasional dinosaur. It is well-researched, nicely presented and is warmly recommended

NATIONAL AEROSPACE LIBRARY



Bristol Scout documentary

On Tuesday, 11 April 2017, a new documentary *Bristol Scout – Rebuilding History* was premiered at Leicester Square's Prince Charles Cinema which relates the remarkable story of the reconstruction by David Bremner CEng MIMechE of his grandfather's 1915 Bristol Scout Type C No 1264, starting from the original stick and rudder bar.

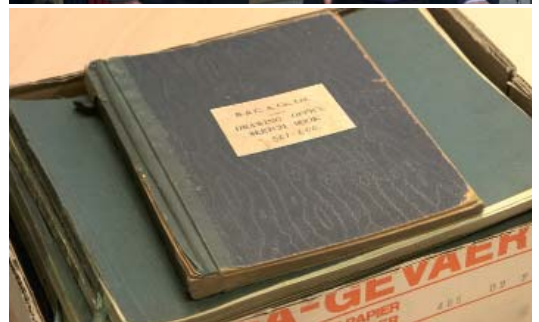
A key part of this reconstruction project was the need to be able to demonstrate full compliance with the original specifications and part of the documentary recreates Mr Bremner's original visit to the Society's Library on 19 November 2007 to view Frank Sowter Barnwell's design calculations for the Bristol Scout, during which the Chief Librarian, Brian Riddle, put Mr Bremner in contact with an American Bristol researcher, Derek Staha, based in Houston, who was to play a major role in the exchange of technical information.

Early trailers for the documentary film can be viewed at: <https://vimeo.com/158969503> and <https://vimeo.com/172725324> and a DVD may be ordered via the website: www.asa-uk.tv/products_page/

Included in the archives of the National Aerospace Library at Farnborough is a wealth of original material relating to The British and Colonial Aeroplane Company and the Bristol Aeroplane Company which was to succeed it, including the company's record book of fuselage construction and repair 1911-1917, numerous internal company reports/brochures, a large number of original notebooks containing the design calculations for a variety of Bristol types compiled by Barnwell, A J Newport, W T Reid, G A Stephens and W G Morgan and 45 large original sheets (c.40 x 27 inches), hand-drawn by Barnwell and others, recording the company's detailed engineering design calculations for the GE2 two-bay non-staggered biplane and its component parts entered in August 1912 for the War Office Military Aeroplane Competition held at Salisbury Plain.

Top right: An original Bristol Scout C. RAeS (NAL).

Top left: A film still of the reconstructed Bristol Scout. Middle right: David Bremner, left, with Brian Riddle, RAeS Chief Librarian, reconstruct the original 2007 visit to the National Aerospace Library to view Barnwell's original design calculations for the Scout, right.



The Library also holds the 'The British and Colonial Aeroplane Company Minute Book No 1' which contains the hand-written accounts of monthly meetings of Directors from its formation in February 1910 through to December 1919 which is among the 'milestones' from the pioneering days of aviation included in the collections that can now be viewed page-by-page – with close-up magnified detailed views available by clicking on the 'Detail' option for each image and moving one's 'mouse' over the selected image – on the Library's heritage website <http://aerosocietyheritage.com> launched in 2015: <http://aerosocietyheritage.com/collections/british-and-colonial-aeroplane-company-minutes-book-1-1910-1919/>

For any enquiries regarding this material, please contact the librarians at Farnborough
T +44 (0)1252 701038/701060;
E hublibrary@aerosociety.com

BOSCOMBE DOWN BRANCH

The Boscombe Down Balloon Challenge

Genesis

As the summer of 2015 turned to autumn, the Boscombe Down Branch committee turned its attention to the Society's (then) forthcoming 150th anniversary, and wondered what it might contribute. Something a bit unusual was needed; something that echoed the first tentative steps in aviation; something practical and fun to do; something that would encourage our next generation of aviators, aeronautical engineers, and scientists; and, because this was all based at MoD Boscombe Down, something that had just a whiff of test and evaluation about it. Finally, since almost any project would cost money, it had to be something that would attract a realistic level of sponsorship.

From this 'shopping list' came the Balloon Challenge; a STEM outreach project for children of secondary school age. Their challenge was to fly a 2m-diameter helium balloon higher, further, or for longer than any of the other competitors; and their reward for doing so would be three Grand Prizes: £1,000 for each category of height, distance and endurance.

The sponsors

From the outset, the Challenge enjoyed a level goodwill and support that was truly superb. QinetiQ and the University of Southampton kindly provided the main prizes. QinetiQ also donated a helium 'fill' to each school that formally registered in the competition; and generally supported the Challenge organising committee in their mission.

A further prize was donated by Chris Hillcox of HAB Supplies. This took the form of a fully-sponsored balloon (much larger than the 2m maximum size allowed in the Challenge); complete with helium, and all the components for a trackable photographic payload.

Many other organisations, businesses, and individuals also helped the Challenge in ways too numerous to mention. The organisers are deeply indebted to all of them.

A two-horse race

Seven schools signed up as registered entrants in the Challenge; and, from these, two rapidly emerged as the most serious contenders for prizes.

Epsom College put in a Herculean effort, launching six flights in all (with a seventh in reserve for the evening of 31 December). This team had a great appetite for the Challenge,



Above: Don Cameron, founder of Cameron Balloons, presents the main prize to the winning team from Epsom College.

Below: First launch from Ryde, Isle of Wight.

and their determination to win it was palpable. Yet, despite being fiercely competitive, they were totally committed to playing strictly by the rules in everything they did. More than this, they respected an advisory launch embargo when the prevailing wind would have carried their balloons into airport traffic zones.

Ryde School with Upper Chine was also an enthusiastic competitor. The Ryde team planned their flights with full cognizance of NOTAM requirements, and with commendable attention to engineering detail. After one false start, which necessitated payload recovery from a nearby tree, the Ryde balloon flew furthest and for the longest duration (by a large margin) but, since the balloon itself was just bigger than the maximum size permitted in the Challenge, this result did not count. It was, nevertheless, a significant achievement in its own right.

And the winner is ...

The Challenge ended with the anniversary year, at midnight on New Year's Eve. In February, pupils and staff, together with other invited guests, attended a prize giving ceremony at MoD Boscombe Down.

Epsom College won all three £1,000 prizes: for greatest altitude, greatest distance, and greatest endurance. Ryde School with Upper Chine (Isle of Wight) won the Chris Hillcox HAB Supplies prize for a commendable flight achievement that did not qualify for any of the three main prizes.

Reflections

There is widespread agreement that the Balloon Challenge was a good thing to do but the number of



school children who benefitted from it is not really known. Some were closely involved and would have learnt much from their practical experience. Others had more peripheral contact but probably took something away from it. Hopefully, they all enjoyed it.

The organisers certainly enjoyed it and they too gained some tangible benefits in the form of graduate CPD.

There is a rather nice footnote: Epsom College is now running a simplified version of the Challenge for children of preparatory-school age. Through this continuing project, active promotion of the STEM subjects (and an infectious enthusiasm for aeronautics in particular) really is being spread to the next generation. We should like to think that the early pioneers would have approved of our efforts. I think they might.

Rod Angel

CEng FRAeS FRIN



The team from Ryde School with Upper Chine describe pre-launch testing to the Prize Day audience at MoD Boscombe Down.



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Afterburner

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- B1.2 Certifying Technician – Aeroplanes Piston
- B1.3 Certifying Technician – Helicopters Turbine
- B2 Certifying Technician – Avionic.

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Thursday 11 May 2017 / London

Annual Banquet

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Aerospace – the long march east

Corporate Partner Briefing by Nigel Stein, Chief Executive, GKN plc

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MAY 2017

EVENTS www.aerosociety/events

9 May

Staying Alert: Managing Fatigue in Maintenance
Human Factors Group Conference
Cranfield University

11 May

RAeS AGM and Annual Banquet

16 May

Safely Enabling Unmanned Aerial System Traffic Management
UAS Group Seminar

16 May

F-35B Initial Ski Jump Testing
Gordon Stewart, Principal Engineer, Flight Physics, QinetiQ
Lecture

18 May

Spies in the Sky: The Secret Battle for Aerial Intelligence during World War 2
Taylor Downing, Historian
Historical Group Lecture

23 May

Aircrew Mental Health: Regulatory and Implementation Challenges
Conference

25 May

Ann Welch Lecture: UK Junior Gliding – The Beginning of the Future
Steve Pozerskis, Registered Valuer, Bruton Knowles
General Aviation Group Named Lecture

1 June

Escort Spitfire? The Missed Opportunity of Extending the Spitfire's Range
Paul Stoddart, Operational Analyst, UK MoD
Lecture

7 June

Digital Connectivity and Cybersecurity Seminar
Conference



MoD/Crown copyright (2017)

12 June

Sir Sydney Camm Lecture: Multi-Domain Warfare in the 21st Century
General Sir Gordon Messenger, Vice Chief of the Defence Staff
Named Lecture

13-14 June

Benchmarking for Improving Flight Simulation
Flight Simulation Group Conference

13 June

Edwin A Link Lecture
Admiral P A Chivers, Director, Military Aviation Authority
Flight Simulation Group Named Lecture

All lectures start at 18.00hrs unless otherwise stated.
Conference proceedings are available at
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LECTURES www.aerosociety/events



The first McDonnell XF4H-1 Phantom II, 142259. The evolution of the F4 Phantom will be described by Dave Ward, Heritage Department, BAE Systems, Warton, at Cosford on 18 May. RAeS (NAL).

BEDFORD

Room LR29, Building 122, Cranfield. 6pm. Marilyn Wood, T +44 (0)1933 353517.

10 May — The Icarus Project.
Dr Angelo Niko Grubišić, University of Southampton.
Joint lecture with Bedford Branch.

BIRMINGHAM, WOLVERHAMPTON AND COSFORD

National Cold War Museum, RAF Museum Cosford, Shifnal, Shropshire. 7pm.
Chris Hughes, T +44 (0)1902 844523.

18 May — Branch AGM (6.15pm) followed by The first of the Phabulus Phantoms.
Dave Ward, Heritage Department, BAE Systems, Warton.

15 June — Operation Varsity.
Steve Wright, GPRA. Joint lecture with the Glider Pilot Regimental Association (GPRA).

BROUGH

Cottingham Parks Golf Club. 7.30pm. Ben Groves, T +44 (0)1482 663938.

10 May — A history of aircraft fatigue from Comet to Dreamliner. Dr Andrew Halfpenny, Director of Technology – nCode Products.

CANBERRA

Military Theatre, Australian Defence Force Academy, Northcott Drive, Canberra. 6pm.

9 May — Tracking and managing space debris. Rod Drury, Space Environment Research Centre.

CHESTER

Room 017, Beswick Building, University of Chester, Parkgate Road. 7.30pm. Keith Housely, T +44 (0)151 348 4480.

10 May — Branch AGM followed by 'I tell my story' short talks by Branch members.

CRANFIELD

Room LR29, Building 122, Cranfield. 6pm.

10 May — The Icarus Project.
Dr Angelo Niko Grubišić, University of Southampton.
Joint lecture with Bedford Branch.

1 June — Lord Kings Norton Lecture. Additive manufacturing. Stewart Williams. Vincent Auditorium, Building 52a, Cranfield University.

CRANWELL

Daedalus Officers' Mess, RAF Cranwell. 7.30pm.

8 May — Branch AGM followed by Being a test pilot. 41(R) Sqn.

5 June — Long-range Spitfire escorts for Bomber Command. Paul Stoddart.

10 July — The combined bomber offensive: mythology versus policy. Gp Capt (Retd) Chris Finn.

FARNBOROUGH

BAE Systems Park Centre, Farnborough Aerospace Centre. 7.30pm. Dr Mike Philpot, T +44 (0)1252 614618.

23 May — The Boeing RC-135V/W Rivet Joint programme. Wg Cdr Garry Crosby, RAF (Retd), former OC 51 Squadron and Wg Cdr Simon Cloke, RAF, current OC 51 Squadron.

13 June — Aerodynamics of LO aircraft. Chris Lee, BAE Systems, Military Air and Information.

GLOUCESTER AND CHELTENHAM

Safran Landing Systems, Restaurant Conference Room, off Down Hatherley Lane. 7.30pm. Peter Smith, T +44 (0)1452 857205.

16 May — The Napier Deltic engine: its development and applications. Nigel Paine, Napier Power Heritage Trust.

HAMBURG

Hochschule für angewandte Wissenschaften (HAW), Hörsaal 01.12, Berliner Tor 5 (Neubau), 20099 Hamburg.

6pm. Richard Sanderson, T +49 (0)4167 92012.
22 June — The RAF Harrier in the Cold War. Gp Capt John Jock' Heron.

ISLE OF WIGHT

Conference Hall, Isle of Wight College, Newport. 6.30pm.

25 May — High altitude, long-endurance UAVs – world-leading UK technology. Paul Brooks.

LOUGHBOROUGH

Room J104, Edward Herbert Building, Loughborough University. 7pm. Colin Moss, T +44 (0)1509 239962.

13 June — Loughborough University MEng Final Year Aircraft Design Projects – series short lectures. Joint event with University Dept of Aero and Auto Engineering.

MEDWAY

Staff Restaurant, BAE Systems, Marconi Way, Rochester. 7pm. Robin Heaps, T +44 (0)1634 377973.

17 May — Branch AGM followed by lecture.

OXFORD

Magdalen Centre, Oxford Science Park, Oxford. 7pm. Nigel Randall, E oaktree. cottage@btinternet.com

16 May — Branch AGM followed by Use of artificial intelligence in aircraft fault diagnostics. Dr Adam Zagorecki, Senior Research Fellow, Cranfield University.

18 July — Airliner development. Andy Barton, Hybrid Air Vehicles.

PARIS

Salle Vinci, 52 rue Jacques Hillairet, Paris 12th.

23 May — Charles Lindbergh Lecture. United Space in

Copy date
for the next issue
of *AEROSPACE* is
3 May.



An RAF Tornado GR4 of 31 Squadron is readied for take off as it prepares to depart Kandahar Airfield, Afghanistan, for the final time. Wg Cdr Paul Morris will discuss the air operations over Afghanistan in the Ernest Dove Lecture at Southend on 9 May. MoD/Crown copyright (2017).

Europe Jan Woerner, DG, European Space Agency.

PRESTON

Personnel and Conference Centre, BAE Systems, Warton. 7.30pm. Alan Matthews, T +44 (0)1995 61470.

10 May — History of Blackpool Airport. Russell Brown.

14 June — Future Hawk. John Hurrell, BAE Systems.

SEATTLE

Museum of Flight, 9404 East Marginal Way South, Seattle, Washington. 6.30pm.

16 May — Introduction to the KC-46 tanker design. Danny Wright, KC-46 Chief Mechanic.

SOUTHEND

The Royal Naval Association, 79 East Street, Southend-on-Sea. 8pm. Sean Corr, T +44 (0)20 7929 3400.

9 May — Ernest Dove Lecture. Air operations in Afghanistan. Wg Cdr Paul Morris.

STEVENAGE

1900 Building, Rooms 1 and 2, The Metropolitan Restaurant, MBDA, Six Hills, Stevenage. 5.30pm.

11 May — Young persons' lecture competition.

SWINDON

The Montgomery Theatre,

The Defence Academy of the United Kingdom, Joint Services Command Staff College, Shrivenham. 7.30pm. New attendees must provide details of the vehicle they will be using not later than five days before the event. Photo ID will be required at the gate (Driving Licence/Passport). Advise attendance preferably via email to raeswindon@gmail.com or Branch Secretary Colin Irvin, T +44 (0)7740 136609.

3 May — All-day visit to RNAS Yeovilton.

SYDNEY

Mechanical Engineering Theatre, University of Sydney, Shepherd Street, Darlington. 6.30pm.

3 May — The European Space Agency Rosetta Mission and lessons for the Australian space context. Warwick Holmes, Executive Director of Space Engineering, University of Sydney.

TOULOUSE

Symposium Room, B01, Airbus HQ/SAS, 1 rond point Maurice Bellonte, 31707 Blagnac. 6pm. Contact: Pass@RAeS-Toulouse.org for a security pass.

16 May — Branch AGM followed by Tenth ADS Lecture. Prof Iain Gray, Director of Aerospace, Cranfield

University.

9 June — Annual Dinner. Château de Larroque, 32200 Gimont.

WASHINGTON DC

British Embassy, 3100 Massachusetts Avenue NW, Washington, DC 20008. 6pm.

11 May — Electric aeroplanes panel discussion.

YEOVIL

Dallas Conference Room 1A, Leonardo Helicopters, Yeovil. 6.30pm. David McCallum, E david.mccallum@leonardocompany.com

17 May — Branch AGM followed by Renewing the Great Western Railway fleet. Andy Mellors, Engineering Director, Great Western Railway. Joint lecture with IMechE.

15 June — Taranis UAV. Chris Clarkson, BAE Systems.

Napier Deltic-powered British Rail Class 55 no 55022 Royal Scots Grey is seen after arriving at Grosmont on 18 September 2009 during the North Yorkshire Moors Railway's annual Diesel Gala. The Napier Deltic engine will be discussed by Nigel Paine at Cheltenham on 16 May. Graeme9022.



AUSTRALIAN DIVISION

Australian aircraft designer wins the 2017 Lawrence Hargrave Award

Domination by US manufacturers of light aircraft since the 1950s left little opportunities for other countries. However, there is an Australian aircraft which was developed and sold worldwide in considerable numbers, the single-seat 'Corby Starlet'. In 1958, John Corby, structures engineer developing repair schemes and modifications on Qantas aircraft, embarked on a lone project to complete the design that had begun in a light aircraft design competition but lapsed.

The Starlet was completed in May 1966 and the first flight was made in August with DCA officials in attendance. The aircraft was registered VH-CBS and, in time, John lodged his application for a Certificate of Airworthiness in November 1971. On 30 June 1972 DCA granted the Starlet the full Certificate of Type Approval, No 74-1, identifying the Starlet as an aircraft in the same approved category as commercial aircraft.

The Starlet arrived on the international scene where John Corby flew demonstration flights at Oshkosh. As a result, a US agency asked for plans and the first of many Starlets was completed in 1986 and construction still continues. Numbers are still flying and construction continues in the US today. By 2016, over 900 Starlet plans had been sold in 30 countries. John is not sure of the number built but believes it is over 150 and it is known that the aircraft is still flying in at least ten countries, including the UK where the Light Aircraft Association, which replaced the ULAA, reported in 2016 that there are at present five Starlets flying with 14 more under construction.

Although current build Starlets are aerodynamically the same as the first, various upgrades have been incorporated, including a bubble canopy and wheel spats and John Corby has redesigned the aircraft in an optional all-metal version named 'Kestrel'.

In 1978, after leaving Qantas, John was appointed General Manager and Chief Designer of Transavia, a Sydney company producing the ingenious, specialised PL-12 Airtruk agricultural aircraft. The Airtruk's most distinctive feature were widely separated, cantilever twin boom T tails which allowed loaders direct, unrestricted access to the fuselage when loading the hopper. The short fuselage featured a tricycle landing gear and a high pilot position for best view and safety. John was employed to engineer an alternative power plant, and supervise development of an improved model, the T300 Skyfarmer and, in 1988, an extended



Above from left: Prof Chris Atkin, RAeS President; John Corby and John Vincent, then Australian Division President. Above right: Corby Starlet, 28-3381. Bauple58.



version with improved aerodynamics. Certification under US FAA FAR23 rules was a major and lengthy undertaking to allow export sales, leading to a number sold and operated in China and other countries. The aircraft was employed extensively in Australia and manufacture continued until 1990, by which time approximately 120 had been produced. Three Airtruks are known to be still flying in Australia and others survive in museums around the world.

In the 1980s, Transavia was contracted to construct a flying replica of a Sopwith Pup, the first WW1 reproduction aircraft to be built in Australasia and, while today New Zealand is a prolific supplier of WW1 aircraft to the world, a project of this nature in Australia at that time was without precedence, and involved pioneering research and engineering. As Chief Designer of Transavia, it fell to John Corby to engineer the replica to modern airworthiness standards. It flew for a number of years at air shows and other events and is now preserved in the RAAF's Point Cook Museum in Victoria. John Corby remained at Transavia for ten years.

John Corby still maintains contact with Starlet builders and flyers around the World but reflects that there is a diminishing market for 'build from scratch' designs in a market now dominated by comprehensive kits with laser-cut components and other developments to reduce production time and man hours. However, numbers of the Starlet will be around for many more years.

In recognition of his life-long career in Australian aircraft design and development, John Corby is the recipient of the Royal Aeronautical Society Australian Division's 2017 Lawrence Hargrave Award.

Jeff Lock

“
IN
RECOGNITION
OF HIS LIFE
LONG CAREER
IN AUSTRALIAN
AIRCRAFT
DESIGN AND
DEVELOPMENT,
JOHN CORBY IS
THE RECIPIENT
OF THE ROYAL
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DIVISIONS 2017
LAWRENCE
HARGRAVE
AWARD



YOUNG PERSONS NETWORK

YPN in the

spotlight

Daniel Young Yeovil Branch

Daniel is an Automatic Flight Control System (AFCS) Engineer for Leonardo Helicopters and currently based at the company's UK site in Yeovil. Daniel has been a committee member of the Yeovil Branch since June 2015 and, during that time, has become the Branch Newsletter Editor, the YPN Representative and co-ordinator of the Engineering Days in Schools initiatives.

Q: Why do you think the RAeS is important for young aerospace professionals?

A: It provides young aerospace professionals a strong support network that can enable them to grow and reach their full potential by offering a wide range of activities that cater to a number of different needs. The RAeS provides numerous opportunities throughout its framework (events, sponsorship, awards and learning resources) that can be utilised by young people looking to further develop themselves in either their careers, or their own personal lives.

What I particularly find rewarding are the opportunities offered through regular networking events and specialist talks and the outreach support structure that allows me to put on STEM events (such as Cool Aeronautics).

Q: Why did you volunteer for the YPN?

A: The RAeS has a long tradition of excellence in aerospace and aviation and that is something I wanted to be a part of. My personal philosophy is to be the change you want to see in the world, because the things we do in life define who we are as a person. Volunteering and actively participating in the YPN is one way I want to shape the future of aerospace.

It is also important to note that the RAeS allows a collection of individuals who have a shared interest to become a community of people working towards a common goal – the advancement of aerospace and aviation across the globe. I believe that the YPN will play an important part in achieving that overall vision.

Q: How do you aim to improve the service of the RAeS to young members at a local level?

A: The key aim I have in improving the service the RAeS provides at a local level is to bring a modern approach to how the Branch operates in my area through increasing our online presence and by creating a large impact on the local community with aerospace-based events.

Communication is another important factor I want to improve within my area, so that we can make people aware of both current and future activities carried out by the RAeS. This is achieved at present through the regular email and face-to-face contact I have with our local young members; however, I am always looking to expand the network wherever possible through the new opportunities offered by social media.

Q: Tell us about a past or future event for young people in your area:

A: In December I organised a Cool Aeronautics event at the Fleet Air Arm Museum (FAAM) which was attended by 151 local primary school students from nine local schools and supervised by 50 young professionals from the local aerospace industry.

The aim of the event was to celebrate 150 Years of the RAeS and 90 Years of the Yeovil Branch, while simultaneously inspiring the next generation to pursue a career within aerospace. The day really captured the imaginations of everyone present and the level of enthusiasm shown by the students was wonderful to see. Due to the success of the event, the FAAM and the schools involved have personally asked if it can be turned into an annual occasion.



THE RAES HAS A LONG TRADITION OF EXCELLENCE IN AEROSPACE AND AVIATION AND THAT IS SOMETHING I WANTED TO BE A PART OF



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MAY 2017

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Kenneth (Ken) Pascoe
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Brian Pearce
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WITH REGRET

The RAeS announces with regret the deaths of the following members:

John C Cannon FRAeS 70
Michael James Collins IEng AMRAeS 85
Edwin Thomas Collins CEng MRAeS 82
Air Marshal Azim Daudpota HonCRAeS 83
William Edward Morris CEng FRAeS 94
Peter Phillips Affiliate 80
Frank Gerrie Willox OBE CEng FRAeS 88

Rachel Solomons
Christopher Tidy

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Sam Carter
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Hugh Kennedy

STUDENT AFFILIATES

Ruvarashe Nyaruwata
Kevin O'Shea
Damian Verbakel

PETER JOHN ALLARD

FRAeS
1934-2016

After a brief battle with cancer, Peter Allard passed away on 27 December 2016. Born in Filton, he qualified as an aeronautical engineer with the Bristol Aeroplane Company, now Rolls-Royce, in Bristol. With two colleagues, Roger Smedley and Ian Creer, the engineering design company, SAC International, was formed in 1961.

Peter joined the Bristol Branch of the Royal Aeronautical Society in 1969, being elected on to the Committee the following year and became Treasurer in 1971 for some nine years. In 1983 he became President of the Branch. His enthusiasm and dedication to the aerospace industry was impressive. He was also a member of The Air

League and served on the UK Industrial Space Committee of the Society of British Aerospace Companies (SBAC).

Always keen to put something back into the Industry, in 1991 he gave funding for an annual medal to the Society. The 'Peter Allard Charitable Foundation' was formed to encourage the training of engineers in the field of aerospace and related industries. Thus the Peter Allard Silver Medal was founded in 1992 which was awarded for practical achievement leading to the use of composite materials in aerospace.

In 1985 SAC International merged with The Ricardo Group plc where Peter played an active consultancy role for many years.

He leaves a widow, Sallie, and daughters Mandy and Sharon.

A fuller obituary for Peter may be found on the Society's website at: aerosociety.com/News/Society-News/

FRANK GERIE WILLOX

OBE CEng FRAeS
1929-2017



Gerrie (pronounced with a hard G, almost as Garry) Willox, who has died aged 88, was a leading light in both the Tornado and Typhoon fighter programmes. His career in the aerospace industry coincided with the time it embraced European collaboration, a change of focus and he was at its centre. Joining the English Electric Aviation Company in 1956, he grew to play leading roles in both the Tornado Multi Role Combat Aircraft (the first major European military collaborative project) and the formative stages of the European Fighter Aircraft/Typhoon. He was the first Managing Director of Eurofighter Jagdflugzeug GmbH, from 1986 to 1991. First flight was in March 1993. His attention to detail

is visible even to this day, in its tidy lines and real capabilities.

Always one to get to the root of any issues that had to be dealt with, he was never one to stand on ceremony; he would always find the person in the organisation, no matter how junior, who could give him the answer he needed. As was said at his well-attended funeral at Wrea Green Parish Church on 7 March, it was a life lived at Mach 2. All who worked with him had the utmost respect for his knowledge and attention to detail. Of the old school, the likes of him will never be seen again.

In 1986 the Royal Aeronautical Society awarded him the Silver Medal and, in the June 1987 Birthday Honours List, he was awarded the OBE. Gerrie Willox is survived by his widow, Elizabeth, and their son Malcolm.

A fuller obituary for Gerrie may be found on the Society's website at: aerosociety.com/News/Society-News/

JOHN AUGUSTUS BEZZANT

IEng AMRAeS
1923-2016



John Augustus Bezzant born on 26 January 1923, becoming an apprentice at the de Havilland subsidiary of Airspeed in Portsmouth in 1939 and progressed to the experimental department.

Two weeks before D-Day John and others prepared nine Horsa gliders, installing circular flanges with explosive bolts connecting front and rear fuselage sections and drogue parachutes, for use in capturing the Benouville and Ranville bridges.

After the war John worked on the Ambassador and became briefly involved with Comet tailpipes. John then joined Folland to organise production of the Midge (a private Folland venture and a predecessor of the Gnat), then became Chief

Production Engineer at Ultra Electric's Gosport television factory.

After Ultra John became Toolroom Manager for Belling and Lee followed by Mallensons in Kent (aircraft floors) and Berg airbrakes in Scotland. After this he and his wife Mabel moved to Bhandup in India as John had secured a position with GKW.

After India, John worked for Tri-ang in Merthyr Tydfil but then started his own small factory 'Shounabath' in Cefn Coed manufacturing steam/shower baths of his own design that were functionally successful but hard to sell. Under contract, John also built digger cockpits for Hymac which failed, owing money to Shounabath which also failed. From then until retirement at 89, John undertook large and small contract jobs in his workshop/double garage.

A fuller obituary for John may be found on the Society's website at: aerosociety.com/News/Society-News/

The Last Word

COMMENTARY FROM

Professor Keith Hayward
FRAeS



Stop all the clocks – well let's hope not

Europe's hopes of deploying an independent satellite navigation system – Galileo – experienced something of a setback earlier this year with news that several satellites had experienced atomic clock failures. These clocks are at the heart of the system's accuracy and clearly vital to the success of the full global constellation of 26 due to be deployed over the next two years. With two sets of clocks, the current fleet of eleven is still operational, and ESA believes the failures were due to problems in switching them back on after a period of dormancy.

The same Swiss-made clocks are also on board the Chinese and Indian equivalents and were procured as part of a drive to ensure European independence in key space technologies. All those involved will be crossing their fingers that this is not a systemic weakness. The next four are due for launch in August on-board an Ariane 5 rocket.

The €3bn programme is the EU's largest space commitment and is overseen by the Global Navigation Satellite Services Agency on behalf of the European Commission. The satellites are procured from OHB by the European Space Agency (ESA) whose Director-General, Jan Woerner, has said Galileo is all about technology leadership, independence and competitiveness. The civilian-run system has had a troubled gestation and was branded an unnecessary duplication by the US but, so close to completion, it will be an important addition to the European space economy. Now that it is marketing its highest accuracy signals to allied nations, Galileo will be a critical element in future European security and military operations.

Ariane 6 and European preference

The search for autonomy in space has been a European objective for several decades and underpinned development of the Ariane launcher family. The fact that Ariane is now the market leader for commercial satellite launches is a perhaps a bonus from a geopolitical perspective. The new Ariane 6 will

face powerful competition from the likes of SpaceX and Russian and Chinese rockets. Airbus-Safran Launchers has again raised the question of forcing European preference on the region's institutional customers. This is a long-standing gripe, with the US and most of the other rocket-owning countries closing their government space markets to outsiders. Ariane 6 promises to be 40-50% cheaper than the current generation and a guaranteed base market should not imply an economic penalty. However, this may still be a hard sell to Europe's smaller or non-space faring countries.

More positively, a French reusable rocket engine programme is getting a €85m boost from ESA, which is ready to sign a contract with Airbus-Safran Launchers that would lead to an engine test in 2020. This is unlikely to affect the emerging competition with SpaceX in the short term, but it could help to keep the European launcher operation in business into the 2030s.

Britain outside the European space market

What these two stories underline is that even a degree of autonomy in space is not cheap. Nevertheless, an independent launcher and global positioning system represents a goodly chunk of independence but there are still several holes in European space – or areas like military communications that are still subject to national or bilateral fragmentation. There is certainly appetite among the major European space powers to continue on the path to greater autonomy in space.

The sad fact is that Brexit may leave the UK space industry struggling to maintain access to this market. It will not happen overnight, as contracts and industrial linkages have a momentum that will carry through after departure. Membership of ESA will not depend on EU membership either but, as the EU funds more of the big space programmes, even Britain's close industrial ties through Airbus Defence and Space may not be enough to escape EU sanctions.



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