



Air Pilot

AUGUST 2019 ISSUE 34





AIR PILOT

THE HONOURABLE
COMPANY OF
AIR PILOTS
incorporating
Air Navigators

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His Royal Highness
The Prince Philip
Duke of Edinburgh KG KT

GRAND MASTER:
His Royal Highness
The Prince Andrew
Duke of York KG GCVO

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Incorporated by Royal Charter.
A Livery Company of the City of London.

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Diary

AUGUST 2019

13th	Visit to Martin Baker	Higher Denham
18th	Annual Garden Party	Biggin Hill

SEPTEMBER 2019

10th	Visit to Southampton University	
12th	GP&F	Air Pilots House (APH)
12th	Court	Cutlers' Hall
17th	Visits Committee	APH
18th	AST/APT	APH
19th	Instructors Working Group	APH
24th	Luncheon Club	RAF Club
	Technical Committee	APH
	Tymms Lecture	RAF Club
26th	Visit to RAF Waddington	

OCTOBER 2019

2nd	Election of Lord Mayor	Guildhall
7th	Pilot Aptitude Testing	RAF Cranwell
17th	GP&F	APH
24th	T&A Banquet	Guildhall

VISITS PROGRAMME

Please see the flyers accompanying this issue of Air Pilot or contact Liveryman David Curgenvin at visits@airpilots.org.
These flyers can also be downloaded from the Company's website.
Please check on the Company website for visits that are to be confirmed.

GOLF CLUB EVENTS

Please check on Company website for latest information

Cover photo: Gloster Gladiator at the Battle of Britain Airshow, 2016, courtesy of Liveryman Alan Jackson.

A message from your Editor...

This has been a season of commemorations. After last year's all-embracing RAF100, this year has seen the 75th anniversary of the D Day landings. Months of planning by many people around the world saw a veritable armada of C47/DC3s cross from Duxford to Normandy. Sadly I missed the event as I was airborne enroute to Spain, and crossing the French coast at the other end of Normandy. The very international flavour of the day was brought home to me by the sound of a trio of US C130s on the radio. I remember well taking my father-in-law (who crossed at D+4) to the 50th celebrations, but doubt I will be present or sentient for the centenary!



Centenaries have continued this year with that of Alcock and Brown's epoch-making transatlantic voyage. I describe a less well remembered transatlantic centenary in the news section. And , as I write, we are recalling the first landing on the moon, fifty years ago. That makes one feel rather ancient.

What aviation events will our descendants be recalling in 100 years' time? Possibly none of the magnitude of the above. But some aviators quietly, some less quietly, continue to impress with their courage, vision and stamina. I was less than impressed with a recent transpolar circumnavigation by a 8 man crew in a G650ER – if that wasn't underlining and abetting the shrinking of the polar icecaps, I don't know what would. But more meritorious to my mind has been a flight from the UK to New Zealand in a 500 kg aircraft by an RAF pilot to commemorate RAF 100. The circumnavigation in an autogyro that is still in progress. And a perhaps naively optimistic attempt to emulate Amy Johnson's journey to Australia (in a Tiger Moth) by Amanda Harrison. We should celebrate that the UK gene pool still holds many brave, if sometimes batty, pilots! Like many others, I look forward to celebrating the achievements of some of our (probably less batty) aviators at the T&A in October.

Paul Smiddy - Editor

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News Round Up

BOMBER COMMAND MEMORIAL PAINTING

The Master and Vanessa were invited to the House of Lords on 9 July to receive a painting of the Memorial Opening Ceremony (in 2012) on behalf of the Bomber Command Association. The painting captures some of the 8000 guests who attended on the day and the very moving "poppy drop" (in memory of the more than 55,000 dead of Bomber Command) from the Battle of Britain Memorial Flight Lancaster.



L-R: Lord Anthony Clarke (Baron Clarke of Hampstead), Ron McGill (the artist, wearing his Bomber Command tie), Lord David Craig (Baron Craig of Radley - former Chief of the Defence Staff)

CROQUET

In the recent Inter-Livery Croquet competition, organised by the Glovers Company, Past Master Colin Cox abetted by a ringer (aka his brother-in-law), Len Howling, came a very creditable third out of out of 24 teams.



PODCAST

I draw your attention to an excellent podcast by Liveryman Captain Hugh Dibley, which can be found at:

<https://www.aerosociety.com/news/100-years-of-piloting-british-airliners-a-podcast-special/>

FOR SALE

PM Colin Cox is offering for sale a third share in a Tiger Moth. Clearly a beneficial aspect to the share is that co-owners are none other than PM Wally Upton and Assistant Richie Piper.

EDITORIAL FROLICS

Due to the generosity of their respective families, the Editor and the Immediate Past Editor both had the opportunity to fly with Past Master Cliff Spink in an ARC Spitfire T9 in the same week. Or perhaps that should read Past Master Spink had the honour to fly two editors in three days! Huge fun.

96-YEAR-OLD WAR VETERAN BACK TO THE COCKPIT

Travel Weekly reported on Past Master Frank Dell, 96-year-old Second World War veteran and former British Airways pilot making a return to the cockpit some 45 years after retiring. Frank was able to sit in a cockpit once again as part of the magazine's commitment to 100 acts of kindness across the world as part of its centenary celebration.



LSL

The annual Livery Schools Link was held over two days in mid-June at the Guildhall. If a fifteen year-old cannot obtain some inspiration for a career from that, they need to think again. The Company as usual generated a significant amount of interest.



RECENT FINDINGS OF THE ALL-PARTY PARLIAMENTARY GROUP ON GENERAL AVIATION ELECTRONIC CONSPICUITY

The comments were revealed in the APPG-GA's response to CAP 1777, the CAA's call for evidence to inform its new strategy on electronic conspicuity devices.

The CAA proposals involve a two stage roll out, starting with mandating conspicuity in selected blocks of airspace before a more general national roll out of the technology nationwide.

Lord Kirkhope of Harrogate, Chair of the APPG-GA's dedicated Airspace Working Group said: *"It is clear that the CAA's objective is to get to a point where electronic conspicuity is made mandatory for every airborne vehicle in the UK. Yet in our opinion the CAA's one-size-fits-all approach will not work for the vast majority of aviation users. The danger in regulating a single common functionality standard is that the solution will not suit everyone. The tendency will be on the part of the CAA to mandate the highest possible performance standard to suit commercial airliners, which would bring unnecessary bulk and complication to those operating small aircraft."*

The APPG-GA's preferred solution would be to allow mixed technologies, tied together by a ground-based relay network (similar to that used in the USA, where commercial air transport uses Automatic Dependent Surveillance-Broadcast (ADS-B) and GA uses Universal Access Transceiver (UAT).

Commenting on CAP 1777, Grant Shapps MP, Chairman of the APPG-GA said: *"The CAA is basing this entire programme on a set of assumed drivers and projected increases to traffic, which we believe more evidence is required to justify. Most infringement incidents are minor and cause no safety risk to commercial travel. It therefore seems that these moves are designed to benefit the commercial efficiency of Air Navigation Service Providers whilst light aviation shoulders the burden. This is especially true as many infringements could be avoided by changing bad airspace designs"*.

"This policy seems like airspace restriction by stealth, especially in an environment where electronic conspicuity is not mandatory. All changes must be put through the formal airspace change process and be subject to a

robust public consultation. Otherwise I fear the CAA would breach its Section 70 responsibilities under the Transport Act 2000."

THE UK'S LOWER AIRSPACE

Lord Kirkhope of Harrogate introduced the report of the All-Party Parliamentary Group on General Aviation (APPG-GA) into the UK's lower airspace with a trenchant conclusion: *"It has been clear to everyone in the aviation community, for some time, that the current Airspace Design Process is unfit for purpose and as a result the UK has one of the most complex airborne environments in the world. The outdated legislation and complex guidance that comes from it, has created a system that is overburdensome and potentially dangerous for future airspace users."*

The expert panel recommended that the Department for Transport and the CAA base their airspace policy on the principles of 'safety, proportionality and need'.

The Inquiry also called for the introduction of a 'ratchet down' process for removing underused volumes of controlled airspace, and that the CAA make a radical shift in its internal processes for airspace change to allow for greater flexibility in future airspace decision making.

Chair of the APPG-GA, Grant Shapps MP, said, *"The 222 MPs and Lords of the APPG-GA welcome the new report published today. Their findings confirm the suspicions my colleagues and I have held about what is going wrong with the airspace design in this country. We are very grateful to our expert panel for their sterling efforts to produce this important piece of work."*

The full report can be found at:

<http://www.generalaviationappg.uk/wp-content/uploads/2019/07/Lord-Kirkhope-Final.pdf>

EXECUTIVE SUMMARY OF THE REPORT

4.1 The current Airspace design model, on all levels, is unfit for purpose. The Department for Transport should seek to radically change or replace Section 70 and the CAA should replace all relevant guidance. This should lay out clear direction and objectives, as well as the

methodology used to arrive their conclusion.

4.2 The CAA should look to radically change the policy objective behind airspace design changes. The Inquiry recommends that the Department for Transport and the CAA adopt, or base their policy on, 'safety, proportionality and need'.

4.2 The CAA should look to ensure that all future airspace proposals make the most efficient use of airspace. The most obvious way this can be achieved is through the introduction of a ratchet down process for classed airspace. This would give the CAA the powers to either lower the class of controlled airspace or make airspace uncontrolled.

4.3 The Government should seek to extend the powers of the CAA, so they can make formal alterations to Airspace Applications. This will bring Airspace into line with all other forms of infrastructure and planning processes. Planning applications in the UK can be altered by the local planning authority and the CAA should be given equivalent powers to make alterations to airspace design proposals.

4.4 The CAA should remove airspace design changes from an individual process internally to a corporate one. This will allow for a more transparent design system, that will see input from broader points of view, thus giving greater scrutiny and better recommendations. This board must have indemnity from prosecution in case an accident deemed to be due to airspace design were to occur but follow the policy and guidance as set out in Section 70.

4.5 The CAA should have an independent review procedure, which must be undertaken after the implementation of an airspace change after 12 months and 3 years of a proposal being implemented. This review must look to match the criteria and reasoning given at the time of the change and look to see if this has been achieved, and if not, why not? The board must also have the power to revoke an airspace design change proposal.

4.6 The Department for Transport should immediately exempt the Airspace Department at the CAA, from the 3% financial return requirement. The

Department for Transport and Her Majesty's Treasury must ensure that the Airspace Design team has adequate resources to ensure that Post Implementation Reviews (PIRs) can occur in the required timeframe.

4.7 The CAA should implement a more flexible approach to airspace design. Looking at factors including the power to 'turning on and off' of Airspace depending on the time of day and time of the year. The Inquiry recognises that this is already being done through the Airspace Modernisation Strategy, but this requires expediting and introducing.

4.8 All pilots of all kinds of aircraft, must remember that a large burden remains on them. If they want a more flexible airspace system, pilots must be willing to follow the rules and keep up to date with any and all changes.

This is considered further by the DAA in his column in this issue.

TRANSATLANTIC TRAILBLAZERS

June this year saw celebrations of the centenary of the first non-stop transatlantic flight – by Alcock and Brown. Their epic 1900 mile journey from Newfoundland took 16 hours, and ended with the aircraft upended in a bog

at Clifden, Ireland. Not that it was ever intended otherwise, it perforce then became a one-way journey.

Less well known is the centenary of the first two-way journey across the Atlantic in July 1919. This was achieved by His Majesty's Airship R34. A veritable behemoth at 634 feet in length. Captained by Brigadier-General EM Maitland, and with a crew of 30 (plus a stowaway and a lucky cat), it departed from its base at East Fortune near Edinburgh (now the Museum of Flight), and landed at Mineola on Long Island on July 6th, after a 106 hour flight (the first East-West Atlantic crossing). Major Pritchard had volunteered to parachute from the airship onto the airfield to brief the ground handlers. Today's long-haul flight crew will be more than faintly jealous at the amount of attention Maitland's men (commissioned and other ranks) received from adoring women when they were wine, dined and partied in New York.

Three days later they set off for the UK. Strangely Maitland was radioed whilst over Ireland by his CO and told to make for Pulham Air Station in Norfolk. This mystified him as all his met reports indicated that the weather at their home base in Scotland was (atypically)

somewhat better than in East Anglia. It also rather screwed up the welcome-home plans of the crew's families, who were waiting expectantly at East Fortune.

The airship arrived at Pulham after 75 hours. It being the weekend, and it not having been the scheduled destination, 'only' 400 ground crew could be procured. But a scratch RAF band was whistled up at short notice. As she came into land, the airship was nose-heavy, so Major Scott, at the helm, released a load of water ballast from the nose – right onto the musicians. Like true professionals that they were, the band soon launched into Handel's magnificent *See the Conquering Hero Comes* until the R34 completed her descent at 0657!

How do I know this? Pulham is midway between the editorial hovel and my home airfield. The village had a terrific exhibition to mark the centenary, and held a weekend of events. It was very encouraging to see a small community mark its (rather rare) aviation heritage with such enthusiasm.



The GP&F recently had a two day visit to RAFC Cranwell and RAF Scampton, where they witnessed a practice display by the Red Arrows.



Master's Message

By **Malcolm GF White OBE**

In 1929 “The future of Air Pilots and Air Navigators was very much in doubt”.

Well, here we are as nonagenarians.

When I crafted my last Message, V and I were just 6 weeks into our year as Master and Mistress. I now write in July, and by the time you read this it will be early August. Life flies by when you are busy and having fun, and a lot can happen. So rather than speculate, I thought I would start with an update, before looking ahead to the Autumn and then close with some reflections.

The Company Livery Dinner is a benchmark in our annual calendar, and Paul Smiddy reported on the evening in the June edition of Air Pilot. Unbeknown to me (and probably Paul), one of my Warden colleagues recorded what was said on the night – so there is no going back. More importantly, many of our guests have since written to say what a splendid evening it was. To quote one: “your dinner was definitely up there with the most enjoyable that I have attended”. I have written to The Master Draper to thank him and his Company for supporting us so well, and in such a splendid Hall. I reflect that we should not take these evenings for granted, as they are special and memorable occasions.

That Captain Stephen Moorhouse RN should have joined us on the night and prior to taking his command at short-notice of HMS Queen Elizabeth and the UK's Carrier Strike Group was a privilege. He and his Ship's Company (sailors and airmen) are now deployed on aviation sea trials involving the F-35 prior to the ship being committed to operational service. Regardless of the changes, I am delighted to confirm that our affiliation with HMS Prince of Wales will remain.

This brings me to our wider connections. Members of Air Pilots have represented the Company at many events in the past month including the RAF College at Cranwell, RAF Cosford, Brize Norton, Odiham, Marham and Valley. And at the RAF Museum, where 601 Squadron (RAuxAF) hosted a reception which included Masters from some 40

Livery Companies. So, to all who have been involved and supported these events – thank you. The Wardens and I look forward to meeting some of you at an informal reception which will [have] been held at Air Pilots' House in July. If it works, we will do more in the future.

Meanwhile, V and I have been privileged to meet with members of many other Livery Companies, the Air League and the Royal Aeronautical Society. And if there have been two common themes throughout, it has been Science, Technology, and Mathematics (STEM) and Young Membership. The Air Pilots were well represented at the London Careers Festival and the Livery Schools Link held in Guildhall in June, where our contribution was relevant, modern and the number of school visitors magnificent. So please make a note to look out for a date in 2020 so you can perhaps support the event next year.

And as promised, the Clerk and I met with a group to discuss Young Membership. We shared some ideas which are relevant to the future – nothing radical and frankly all common sense. We will develop the ideas and report to the Court in September. But one key conclusion is that we and the Court in particular, must do more to help mentor those who want to pursue a career in aviation. Arguably a no brainer as we share a wealth of experience – but it seems that despite the extraordinary efforts of a few, we don't always share it very well.

Looking Ahead

As I write the Royal International Air Tattoo is on the horizon, while business, committee work and events continue at their usual pace. But August seems set to be a slightly quieter month when V and I look forward to joining friends and colleagues at Biggin Hill on 18 August. We will use the time to confirm what we hope to achieve on your behalf when we visit our Regions later this year. I will report on that in the October edition and look forward to being with many of you at the Trophy and Awards Banquet on 24 October. Before then our Patron will formally open, Air Pilots' House. V and I will “Drive a Sheep” across London Bridge on 29 September, and as this is close to Head Office it perhaps offers an opportunity for a small informal get-

together in Borough Market?

Reflections

To close, I share some of our reflections based on 4 months as Master and Mistress, and rather more than just 6 weeks.

The reputation of Air Pilots' as a City Livery Company is strong. The colleagues we have met come from a breadth of backgrounds and industries, and each has commented on the size and reach of our Company; and the relevance of what we seek to deliver. Especially our focus on youth and training. Furthermore, at the Election of Sheriffs held in Guildhall on 24 June Professor Michael Mainelli made specific reference to our international perspective – credit indeed.

Along the way we have developed friendships with many like-minded people, often opening doors to opportunities for our Company which I for one, had never thought of or considered. I reflect that V and I are representatives of Our Company for one year when we can fly the flag and importantly, listen and learn. But the heavy lifting remains with the Clerk, the GP&F, the Court and our Members. And let me add a message to our Members – one day of practical support from each Member a year would represent the equivalent of taking on 5 fulltime employees. We are a Charity, so please consider what you might do.

We also thrive on communication and our Company website gives you all you need to know. The Clerk's e-mail update is always informative and timely. But to fulfil our role V and I will always welcome feedback; so if you have any comments please do contact us at master@airpilots.org. Our reply might not be immediate, but we will respond.

Finally, this has been a time of Remembrance as we marked the 75th anniversary of D-day and the annual UK Armed Forces Day. At one point a Dakota flew over the high street where we live; people stopped and applauded. It made me think as I know that some in our Company have recently lost family and friends. It is right that we look back and never forget. It is also right that as we look forward, we remember what they did for us.

From the Desk of the Director Aviation Affairs

Liveryman John Turner

FUTURE AIRSPACE – SHARE IT OR RATION ACCESS?

A late 19th Century proverb reminds us that, “You cannot get a quart into a pint pot.” Yet that increasingly seems what we are trying to do with UK airspace, to accommodate the increasing demand from manned and unmanned aviation (and possibly from space vehicles and astronauts in the future).

The demand for UK commercial air travel continues to increase: commercial passenger numbers rose by over 8% from 2017 to 2018 and a more recent snapshot shows the number of UK air passengers uplifted [1] this March rose by over 36% from March 2018. Unsurprisingly, airport applications for more controlled airspace continue apace.

Objective statistics on General Aviation (GA) activity levels are difficult to find but since 2017 and, despite Brexit prompting some owners to look for alternatives, in the number of fixed wing aircraft in the 751kg-5,700kg weight category with valid UK registrations has increased [2]. Subjectively, despite increasing airspace congestion and fewer airfields available to GA pilots, the demand for GA flying feels at least as high as ever.

Today (5 July 2019) the Civil Aviation Authority (CAA) has 4944 current approvals for commercial drone operations [3] with drones of up to 20kg. When compared with the equivalent approval numbers for 2013 and mid-2016 of 110 and 1,769 respectively. [4] Applications for Temporary Danger Areas to segregate and conduct commercial drone operations are up 217% on last year. Just to add to the mix, three space vehicle launches are expected to take place from the UK before the end of 2019. Demand for airspace access continues to rise but the volume of that airspace has remained unchanged, if not reduced by the spread of congested areas driven by the need to house an ever-growing population.

The origins of today’s difficulties can be traced back to the period after World War 2, when designated airspace was established around principle national/international airports and along linking ‘airway’ corridors to protect the increase in civil air travel. Within this airspace, aircraft were controlled so airliners could operate without fear of collision; other aircraft were prohibited from penetrating this ‘controlled airspace’ unless granted permission by Air Traffic Control (ATC). The size of airspace around airports and of the airways reflected both the accuracy of aircraft navigation systems and the space required for ATC without the assistance of radar. Segregating the limited number of airliners from other (mainly military) aircraft was a sensible way to achieve safety and only required limited volumes of controlled airspace; vast swathes of UK remained available to non-airliners.

Thereafter, segregation continued as the UK’s way to provide air safety. As more civil airports opened, each demanded a surround of segregated airspace and whenever established airports predicted an increase in activity, they demanded even more airspace to keep their airliners safe. Similarly, larger volumes of ‘reserved’ airspace were seen as the only way to accommodate safely faster and larger aircraft. By 2017, growth in passenger air traffic levels, even with reduced military flying, had squeezed other aircraft into the ever-reducing remainder of free airspace. Demands to increase the volume of controlled airspace continue today, prompted inter alia by the introduction of larger military transports, the increased distances involved in practicing modern air warfare operational and weapon delivery techniques and predicted increases in aircraft movements at aerodromes. Those demands still follow the paradigm established in the 1950s, that “bigger/more aircraft, means we need more airspace” but in practice, “this

airspace is mine,” means “it is nobody else’s.”

There is no dispute that controlled airspace protects the aircraft permitted to operate within it. However, continued expansion means continued contraction of the non-controlled airspace available for other users; this increases the density of all the air traffic outside controlled airspace which in turn increases the risk of mid-air collision and, ironically, may also make those aircraft more likely to infringe controlled airspace.

If we continue with the paradigm of segregation for safety, there will come a time when we have significantly to reduce some sectors so that others can survive. Commercial air transport, providing the greatest economic benefit (£85 billion in 2017) may feel secure. However, in a little over 10 years the number of drones in business and the public services is forecast [5] to reach 76,000, providing an increase of £42 billion in UK gross domestic product, 628,000 jobs, £16 billion in net cost savings to the UK economy. GA’s current contribution of £2 billion economic benefit and nearly 40,000 directly- and indirectly-supported jobs seems small in comparison, but it is GA that provides not only the pool of trained pilots to feed the airlines, but also the seed-corn of opportunity, experience and motivation for many to study and take up science and aviation/aerospace-related pursuits and careers. We made many of the earlier points last October to the Lord Kirkhope Inquiry into airspace change for the All-Party Parliamentary Group for General Aviation, summarising our evidence as follows:

“The intent is not to make airspace less safe for anyone but to make airspace safe and accessible to everyone, including the future commercial drone operators who will demand increasing safe access to support their commercial viability. The current approach of simply blocking off increasingly large portions of UK airspace has served well in the past but becomes increasingly untenable.

The technology behind modern air vehicle navigation and collision avoidance systems opens up new ways to organise (and to charge for using) national airspace and to accept new types of air vehicle, whether those are simply

replicating current manned aviation or expanding into new and potentially unforeseen roles in the future. The aim of those changes should all be to make UK airspace safely accessible to everyone to the maximum extent possible.”

It was against this background that in June I found myself at the CAA’s “Share the Air (Electronic Conspicuity)” conference. Dame Deirdre Hutton, Chair of the CAA, opened the event by reflecting on UK GA’s relatively poor accident record, with Airprox analysis showing that ‘See and Avoid’ was only 36-56% effective in preventing an encounter; some reports concluded an accident was only avoided by ‘good fortune’, which was also hardly effective as a safety tool. Most significantly, she recognised that the solution to making UK airspace effective and efficient into the future was **“Integration not Segregation.”** Accordingly, the CAA vision was to achieve an environment where users could share the airspace with safely assured by modern technology; this would first be introduced into targeted blocks of airspace but eventually the aim was to cover all UK. She pledged that the CAA would be transparent and fair, engaging with everyone throughout the process; the conference, attended by representatives from every sphere of UK aviation as well as many CAA managers, and was actually an important part of that engagement.

Mark Swan, Director Safety and Airspace Regulation at the CAA, emphasised that this was not simply a drive to get everyone to use ADS-B [6] – “other forms of electronic conspicuity are available” – though the systems used did need to be mutually compatible. CAA CAP1727 [7] indicates that about 17% of fixed-wing aeroplane pilots were using ADS-B, mostly integrated with a Mode S transponder, a further 33% flew Mode S-equipped aeroplanes not adapted to use ADS-B and almost 90 per cent of glider pilots who responded use FLARM – the anti-collision system designed specifically for gliders. Almost 90% of respondents believed that full electronic conspicuity across the GA fleet would benefit safety as a whole, with 83 per cent of aeroplane pilots identifying collision avoidance and

improved cockpit/ground-based situational awareness as the principle benefits. In terms of costs, 90% were willing to spend more than £100 on conspicuity equipment with 40% prepared to pay between £100-£250 and 50 per cent willing to invest £250-£500.

The conference heard about an extremely successful Traffic Display Trial [8] at Manchester City Airport and Heliport (Barton), based on ADS-B ground displays and additional ADS-B units installed in Barton-based aircraft. It showed the vastly improved awareness that electronic conspicuity can provide airfield Flight Information Service Officers, allowing them to prevent an airspace infringement they previously could not have been possible. The ADS-B broadcast signal is essentially ‘line of sight’ and the trial also revealed that ‘Portable’ ADS-B units, prone to transmission blanking by aircraft structure or even the pilot’s body, are less effective than installed units linked to proper aerials; rotary aircraft bring their own challenges to transmission patterns and needed specific units. It was also quickly apparent that, while battery-power units were adequate for many ‘private’ flights, flying club aircraft that were in constant use through the day drained the ADS-B battery before the aircraft had completed its day’s work. Finally, notwithstanding the improved FISO awareness, pilots quickly concluded that they would really like ADS-B ‘in’ to receive situational awareness and meteorological data. (In the United States, ADS-B ‘in’ is considered the ‘poor man’s TCAS’ [9].)

Despite the evident potential for ADS-B-in to allow self-separation, repeated mention of Traffic Management and ‘Known Environment’ began to suggest that the proposed new world would be an ATC paradise (and for some pilots, a hell). That impression was dissipated when Julian Scarfe of PPL/IR UK and Europe [10] spoke about ‘Air Traffic Management in a world with Electronic Conspicuity – a General Aviation Perspective.’ He started with a mathematical approach (mid-air risk and self-separation has long been a subject for

mathematical modelling) [11]. Julian derived the risk of collision as proportional to $(1 - p) \times N^2$ where ‘N’ represented traffic density (number of aircraft/unit volume) and ‘p’ the probability of the pilot detecting an impending collision (if ‘see and avoid’ is as ineffective as mentioned at the start of the day, would be a figure between 0.44 and 0.64). i.e. the risk of collision was proportional to the square of traffic density and, especially given the poor effectiveness of ‘see and avoid’ in collision avoidance, traffic density was always the dominant factor in mid-air collision probability. He therefore concluded that at one end of the scale, where traffic was really dense (e.g. around busy international airports) air traffic management would be required. However, at the other, traffic density and collision risk would be so low that ‘see and avoid’ (without electronic conspicuity) would be adequate [12]. Instead of the present airspace Class A to G matrix, he suggested three categories would suffice:

- **Managed.** Mandatory electronic conspicuity (with secondary surveillance radar) and air traffic management.
- **Autonomous.** Mandatory electronic conspicuity (e.g. ADS-B In or compatible systems) with users detecting and avoiding others. This would provide a known traffic environment for the users, not necessarily under tactical control.
- **Unregulated.** Traffic density low enough to permit operation without electronic conspicuity.

Although it was not covered in the conference, an Airspace for All (A4A) [13] analysis of the 101 of all UK mid-air collisions (about 8% of fatal accidents) from 1975 to 2018 provides further insight. Of the 202 aircraft involved in mid-air collisions, 5 were military aircraft (comprising 2 Tornado, 1 Jaguar, 1 Tucano and 1 A-10) and the remainder were civil, comprising 89 powered aircraft (of which 7 were glider tugs) and 108 gliders. The report concludes, “Predominately, powered aircraft collide with other powered aircraft and gliders collide with other gliders. 57% of

collisions between powered aircraft occurred near the airfield and 91% of glider collisions occurred near the launch site. Geographically, the highest risk to all aircraft is close to airfields and launch sites towards the south of England. The majority of collisions occur in areas of known high traffic density, so warnings or alerts need to be specific.”

A4A showed most collisions occurred *within* (rather than *between*) classification groups (the glider tugs all collided with gliders) and a specific solution for glider v glider collisions could have prevented 97% of glider collisions while a specific solution for powered aircraft v powered aircraft collisions could have prevented 85% of powered aircraft collisions. Today there are some solutions; FLARM [14] provides collision avoidance warning and cueing and is installed in a large proportion of UK gliders and many powered aircraft. There has been only one recorded collision between FLARM-equipped gliders in the UK FIR, it is widely deployed in Germany and is mandated for all gliders in the France; the European Union Aviation Safety Agency has also approved FLARM for fixed installation in helicopters. A4A were clear that transponder/secondary surveillance radar-based conspicuity will not resolve the powered aircraft problem as their collision risk is greatest with multiple nearby traffic in the highly dynamic situation close to an airfield; that would require a device capable of alerting the sudden risk of imminent collision and providing avoidance cueing. This highlights one of the challenges in moving towards airspace to which all have access; electronic conspicuity will need to cater for the range of operating scenarios adopted by different aviation sectors, including unmanned.

Aside from FLARM, a number of different solutions have sprung up for the GA pilot, including ADS-B, iLevil, PilotAware, Power FLARM, SkyDemon, SkyEcho and Stratux. Some, but not all, purport a degree of interoperability. This is often achieved through compatibility with GDL 90, a Universal Access Transceiver (UAT) certified to support an array of ADS-B services and broadcasting position, velocity, projected track, altitude and flight information to other equipped aircraft. Interoperability will inevitably be the major challenge for equipment in the future. CAA believe an integrated, affordable solution in the £300-400 price bracket is achievable and anticipate that technology can be relied upon to solve the interoperability challenge (in the same way that the VHS/Beta-Max differences were resolved).

CAA’s Head of Unmanned Air Systems re-emphasised that continued airspace segregation is not unsustainable. Her department leads the electronic conspicuity programme which is aimed at allowing all types of airspace user to share not only the airspace but also the cost and resilience that more flexible use of airspace should bring. Operation Zenith [15] at Manchester International Airport in November 2018 had already shown that it was possible to provide sufficient visibility of the air environment to integrate drone and manned air vehicles with sufficient autonomy within a complex environment safely.

In other developments, drone manufacturer DJI are installing ‘DJI AirSense’ in all their new drones above 250 grams; ‘AirSense’ provides the operator with information on all aircraft and helicopters in their vicinity transmitting ADS-B “with enough time to take action.” In the United States, as part of their ‘NextGen programme the Federal Aviation Administration has decided that only ADS-B meets their requirements for surveillance (as good or better than current systems), cockpit advisory services (providing traffic, weather and database products to improve pilots’ situational awareness and decision making) and cockpit critical services (enabling advanced displays to

allow less separation between aircraft and ultimately transfer some separation responsibility from ATC to the pilot). All aircraft flying in most of US controlled airspace must be equipped with ADS-B out from 2 January 2020.

To summarise, in line with our input to the All-Party Parliamentary Group last year, the CAA is committed to develop shared rather than segregated airspace, through the deployment of modern technology. There are still many significant hurdles to overcome to turn the aspiration into reality, not least the following:

- The level of safety currently enjoyed by commercial air transport operating in controlled airspace must be maintained. The CAA pledge that any implementation will be as safe, or safer than at present. Full deployment of electronic conspicuity should improve massively the safety commercial flights into airports that are not surrounded by controlled airspace.
- Interoperability will need to be carefully defined. For instance, does ‘interoperable’ mean air-air, air-ground or both; does it mean compatibility with TCAS? (It seems self-evident that any solution must, at least, be backwards compatible with TCAS.)
- Electronic conspicuity will need to cater for the range of operating scenarios adopted by different aviation sectors, including unmanned.
- ICAO issue UK a limited number of aircraft IDs; requiring one for all manned and unmanned vehicles may exceed the national allocation
- ADS-B transmission range is line-of-sight to about 100 nm, though lower-powered units will have less range.
 - o Would there be sufficient bandwidth to accommodate every flying vehicle will carry electronic conspicuity.
 - o ADS-B portable devices carried inside the cockpit suffer particularly from transmission blanking by aircraft structure and even the pilot’s body; the cost of embodiment with aerial connections will be much higher than the unit cost of a simple device.

The Uavionix SkyEcho portable conspicuity device (ADS-B in & out) for the UK market



- Conceptually, ‘sharing’ only part of the UK’s airspace through the deployment of electronic conspicuity feels rather like ‘segregating’ by other means.
 - o Notwithstanding the reduced risk inherent in areas of low traffic density, would it be reasonable to forego a possible increase in safety?
 - o ‘Sharing’ will, by definition, allow aircraft/air vehicles to operate in areas from which they were reasonably excluded. Notwithstanding the potential that electronic conspicuity offers safely to increase traffic densities in those areas, it would still seem reasonable to maximise the volume of airspace in which sharing occurs (and permit more flexible routing). Once started, it seems inevitable (and perhaps desirable) that electronic conspicuity-enabled airspace ‘sharing’ extends across all UK airspace.
- “Conspicuity” is very difficult to pronounce in a number of languages (Americans use the term “Remote ID” instead of electronic conspicuity).

FULL CIRCLE

Perhaps we will put a quart of air activity into a pint pot of airspace without spilling anything after all.

NOTES:

1. Excluding passengers on sub-charter operations
2. <https://www.caa.co.uk/Data-and-analysis/Aircraft-and-airworthiness/Datasets/Aircraft-register-statistics/>
3. <http://publicapps.caa.co.uk/docs/33/20190705RptUAVcurrent.pdf> (as at 5 July 19)
4. <https://www.nesta.org.uk/blog/uk-drone-industry-map/>
5. <https://www.pwc.co.uk/intelligent-digital/drones/Drones-impact-on-the-UK-economy-FINAL.pdf>
6. ADS-B (Automatic dependent surveillance—broadcast) periodically broadcasts the aircraft’s satellite navigation-based position. Other aircraft can use receive and use that information to provide situational awareness and allow self-separation; the broadcast can also be received by air traffic control and used in a similar manner to secondary surveillance radar data; it can also. ADS-B is ‘automatic’ in that it requires no pilot or external input and ‘dependent’ because it needs data from the aircraft’s navigation system.
7. <http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=8864>
8. <https://airspace4all.org/barton-go-live-on-our-ga-airfield-ads-b-traffic-display-trial-1st-march-2019/>
9. Traffic Collision Avoidance System <http://interactive.aviationtoday.com/unlocking-the-benefits-of-ads-b-in/>
10. <https://pplir.org>
11. <https://ifly.nlr.nl/documents/P10.1%20ALAA-ATIO2007BlomEtAlPreprint.pdf>
12. The ‘very low density’ case is sometimes referred to as the ‘big sky’ theory.
13. MID-AIR COLLISIONS: AN EVIDENCE BASED ANALYSIS OF RISK 1975 to 2018 A Paper by Airspace4All Version 5.2 Approved 24 April 2019 <https://airspace4all.org/reports/mac-evidence-based-analysis-of-risk-1975-2018/>
14. FLARM is an electronic system used to selectively alert pilots to potential collisions between aircraft. It is not formally an implementation of ADS-B, as it is optimized for the specific needs of light aircraft, not for long-range communication or ATC interaction. FLARM is a portmanteau of “flight” and “alarm”. (From <https://en.wikipedia.org/wiki/FLARM>)
15. <https://www.arpa.uk/operation-zenith-the-uks-most-comprehensive-drone-trial/>



“Human Radar”

By Assistant Richie Piper, Photos courtesy of the RAFBF

The Air Pilots Benevolent Fund (APBF) often works in partnership with other organisations to support beneficiaries such as the RAF Benevolent Fund (RAFBF) and SSAFA, the oldest tri-service military charity. Because of this connection, the RAFBF invited APBF Trustees to the launch of a major campaign at a rain threatened evening at RAF Odiham.

The RAFBF currently provides support to 53,000 people and was very involved in the RAF100 celebrations last year. This year the RAFBF celebrates its own centenary and Chief of the Air Staff, Air Chief Marshal Sir Stephen Hillier has committed the RAF to support the RAFBF in a similar fashion. The objective is to reach out and support a further 47,000 people, which is estimated to cost £30million over three years. The RAFBF reserves already have £20million of that funding and the remaining £10million will be raised along the way. Under the leadership of Air Vice-Marshal David Murray, the RAFBF Controller, the campaign was launched at RAF Odiham to reach out and find those people in the RAF family who need help but have not come forward.

David confirmed that the priority is to continue to support the WW2 generation but increasingly, those that served under National Service would need assistance. It is sobering to note that the youngest National Service person is 73 years old and many do not believe they are entitled to support. Hence the campaign “Join the Search. Change a Life” was launched with a Human Radar at RAF Odiham to reinforce the message that the wider community are being asked to nominate those the RAFBF can help.

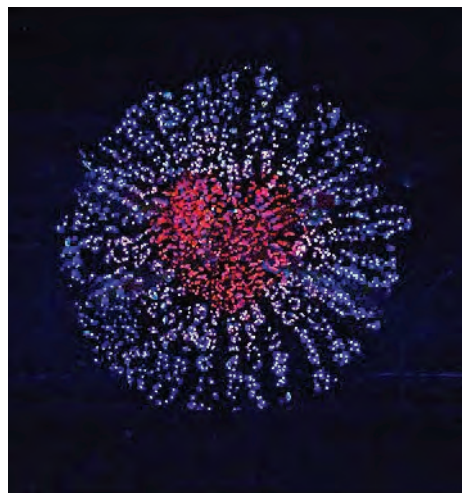
The evening started with a reception in the Officers Mess where David Murray spoke about the objectives and Sir Stephen Hillier confirmed the RAF's support. It was also an opportunity to

welcome two WW2 veterans George Dunn and Cecil “Chick” Chandler, who would later be at the very centre of the Human Radar. There was drill display by the Queen's Colour Squadron who would also later perform a drill in the dusk with LEDs attached to their SA80 rifles.

There had been a threat of rain, with even a Met Office Yellow warning overnight, so we were slightly concerned as we headed over to a disused runway for the filming with a few spots of rain. This was despite the assurances of the Chaplain-in-Chief Air-Vice Marshal John Ellis who had been in touch with his other “boss”!

As we waited for it to darken sufficiently, we experienced light rain in patches and there were concerns when the drone operator said his machines could not fly in rain. However, the Chaplain-in-Chief had done his job well as, when the rain stopped at dusk, we were instructed to take positions. Over two thousand LED wristbands had been laid out on the ground like spokes of a wheel. When in position, each person had to put a band on each wrist and hold their hands above their heads. Then the LED lights were remotely controlled whilst the drone filmed from overhead. Being at the centre of the Human Radar we could see the lights changing all around but had no real idea of the effect. However to get an impression, the RAFBF uploaded a video of the launch which can be seen on YouTube at <https://www.youtube.com/watch?v=RIZT-RH7VQI>

So apart from attending the event to support a Benevolent Fund partner, what is the relevance to the Air Pilots? Simply, as part of the aviation community, we can do our part to put the RAFBF in touch with those members of the RAF family who may need some help.



CAS at heart of the Human Radar
Photo by Richie Piper



GNSS and the threats to Navigation

by **Liveryman Richard Lotinga**

All of you reading this will be aware of GNSS (Global Navigation Satellite System), and most will have used the system to navigate to an ILS or used it to non-precision limits. What you may not be aware of is how prevalent GNSS will become and the vulnerabilities to which you, as pilots, will be subject.

There are several current satellite systems; GPS (Global Positioning System), GLONASS (Russian acronym), Galileo and BeiDou (European and Chinese systems which will both not be fully operational until 2020). All provide position information from between 18–30 satellites orbiting in medium earth orbit at about 20,000 kms. They work on different frequencies at roughly 2Hz so current aircraft avionics will only receive the tuned satellite system. There are receivers in development to receive all the various frequencies. There are a few limited satellite systems that are regionally based (India for one) that are purely for the 'local' national area. All the systems are able to provide accuracies to a high degree but the commercially available accuracy is in the region of 15 – 30 metres, good for some approaches but not CAT1 or better.

ILSs are expensive to install and maintain, and are limited to one runway. Accurate to metres to allow Category 3 approaches, they are currently the only aid that allows pilots to land in very poor visibility. However, there is a new kid on the block: GBAS (Ground Based Augmentation System). This allows a ground installation to enhance the non-military accuracy of a GNSS to match the accuracy of a CAT3 ILS. The other major benefit is that one GBAS installation can provide up to 48 approaches at one airfield. GBAS is accurate out to approximately 23 nm from the transmitter, requiring raw GPS or IRS to provide the navigation for the initial approach.

The cost advantages are enormous, as is the flexibility to provide approaches to any one airfield. Honeywell Aerospace is the main (and currently only) contractor in the West (the Russians have their own system), and has installed systems at

several US airports (such as Newark), and also in Germany, Spain, Switzerland and Australia. Australia is very keen on the system and is decommissioning its ground based electronic aids in some 50% of the original installations.

We all know that NDBs are rapidly disappearing and in my view no great loss, but VORs may well be next to go. With medium and long-range navigation assured with IRSs and GPS is there really a need for VORs? Until now FMCs (Flight Management Computers) have relied upon DME/DME or VOR/DME to provide cross checks on the accuracy of the on-board IRSs. In order, GPS, LOC, DME, VOR and finally IRS are used to provide your position. With the potential demise of VOR/DME and the small availability of Localizer/DME your navigation position will be derived from GPS or your own IRS.

Can GPS be jammed? Oh yes! In a recent major NATO exercise in the Baltic region, finishing in November 2018, GPS was jammed and caused many instances of GPS failures ranging from metres to kilometres in loss of position. This affected not only military systems but also commercial aircraft, with several aircraft reverting to IRS navigation. Russia almost certainly was the culprit having equipped its forces not only with long-range disrupters, but also with short range hand-held devices for its troops. The US Federal Aviation Authority in October 2018 issued a warning to US aircraft flying over the eastern Mediterranean region of the increased threat of Russian electronic warfare jamming: "Be aware of possible loss of GNSS (global navigation satellite system) signal within Beirut FIR (flight information region) due to unforeseen reasons".

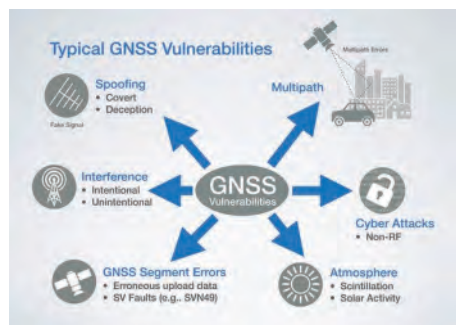
Although the military difficulties are not our immediate concern, commercial navigation is very much our bailiwick, and needs to be addressed. If hand-held devices are available to ground based troops in short order, I would not be surprised if those devices found their way to criminals/terrorists or those of a nature who throw bricks off motorway

bridges or try to blind pilots and others with laser devices. Whereas the perceived threat was from a high powered transmitter hidden in a lorry close to an airfield blasting away any GPS signal, a small hand-held device may be more insidious and well-nigh impossible to detect (as have the lone-wolf use of laser pointers). At least a laser device provides its own position by its use; a hand held GPS disrupter currently offers no such clues.

I wish that the above threat was the only danger to GNSS and aviation and maritime navigation. There are others.

Solar disruption is a major threat that can be detected but not avoided. Science has increased its understanding over recent years of an extreme space weather event, such as the "Carrington event" of 1859. Today, this type of event would be likely to disrupt satellite signals and operations temporarily – and in extreme cases permanently – due to the satellite being exposed to elevated levels of radiation and energetic particle effects. Extreme space weather could also disrupt ground support for space activities, as well as the power networks, communications and aviation. Orbital debris (graphically displayed in the 2013 film 'Gravity') is likely to become an increasing problem. Since 1995 space-faring nations have coordinated to reduce the problem but the issue will remain for some time.

Cyber hacking and attacks are a major issue. Any individual with a computer and access to the internet can attempt to hack into organisations and often have some success. Cyber-attacks can occur at levels from government sponsored attacks to a single individual with social interaction issues. These attacks are difficult to anticipate, contain, and combat. Attacks can be on satellites, ATC or any system connected to the internet. A report to the US Congress in 2011 found that hackers had been able to infiltrate and disrupt two US satellites on four occasions in 2007 and 2008. Landsat-7, a NASA Earth observation satellite, experienced interference in October 2007. The breach was only discovered following interference with another satellite, Terra-AM-1, in July



GNSS threats summarised by GPSworld

2008. The report for Congress concluded that, in interfering with Terra-AM-1, “the responsible party achieved all steps required to command the satellite.” The hackers were assessed as likely to have been working for another state, gaining access through a Norwegian commercial ground station connected to the internet. What are the alternatives? ILS still exists and may have to be retained at major airports as a back-up system. On-board systems, such as IRSs, are too inaccurate for anything other than non-precision approaches at best and they need some form of accuracy check via GPS or DME. An updated IRS known as TIMU

has been development for some time but is still not ready for wide-spread use. ADS-B (Automatic Dependent Surveillance-Broadcast) used by ATC and flight trackers is an always-on on-board system which might provide some sort of back-up. Equally, ATC/SSR overlaying primary radar is an alternative that might provide a basic non-precision approach aid, particularly if it could be data-linked from the ATC radar to an internal on-board FMC. From a maritime perspective e-LORAN is an updated electronic version LORAN. It could, at some cost, be revitalised from its generally mothballed state but would require receivers and avionic integration. It is unlikely to be viable option.

GNSS is an excellent system. With GBAS, CAT3 approaches in due course will be available at any installed airport. Costs will be reduced with an expanded approach network to multiple runways at any one airport. What’s not to like?

The threats are multiple and nefarious. From solar and orbital debris to cyber hacking by an individual or by state



sponsor to GPS jamming at a wide-area to local hand held devices. There are no known defences against any of these threats. There may be warning of space events and some wariness when nations are in conflict, rather than actual war, but against the lone wolf attack there will be no warning of any sort.

The aviation industry requires a back-up system. ILS should be retained for the immediate future and perhaps a select number of VOR/DMEs. A reassessment and development of IRSs would be welcomed, to at least make guaranteed approaches to a non-precision level. The aviation industry has an enviable safety record; we need to ensure that that record is maintained.

GAZETTE

APPROVED BY THE COURT 18 JULY 2019

ADMISSIONS

As Upper Freeman

Glen Edward BRAZ (AUS)
 Ian Michael CALTON (HK)
 Tammy CAMILLERI (AUS)
 Emma Margaret CARTER
 Brett Matthew CLAYTON (NZ)
 Paul DOYLE
 Christopher John KEMPIS (HK)
 David Frederic MacNEIL (NA)
 Hugh Lyell NICHOLS (AUS)
 Jeffrey Philip TRAPPETT (AUS)
 James Edward WINSPEAR
 Edward Martin YARD (HK)
 Martyn Stuart YOUNG

As Freeman

Robert WOOLLARD

As Associate

Tim COOPER
 Kallel Carl KEMP (AUS)
 Robert William HOYLE (AUS)
 Monica Jeanette KLEINRAHM (AUS)

As Upper Freeman

Bobby Sean GALLAGHER
 Gilbert Patrick DOUGHERTY

RESIGNATIONS

Richard BULGER (NZ)
 Martin DOLE-WASILKA
 John McGWYNE
 John RICHARDS
 Kenneth SHERWOOD
 Kayed SUKKAR (OS)

ACKNOWLEDGED BY THE COURT

18 JULY 2019

REGRADE

To Livery

Christopher Brett REYNOLDS
 Stephen John SMARTT

Company visit to RAF Valley - 29-30 May

By the Editor, Photos by the Editor, James Alexander, Ian Ritchie and Richie Piper

If this year's Cobham lecture (see the June edition), was the theory, this visit was the practical. We were hosted by our Cobham lecturer, Wg Cdr Rob Caine, OC of our affiliated unit, IV (AC) Squadron, who was very keen we should see how the reshaping of 4 FTS was working. More than forty Company members attended, and some twenty pilots had planned to fly up - to land at Mona (Valley's relief landing ground). Sadly the weather gods were in a foul mood, and we all arrived at a very windy and wet Valley by car, with clag arriving just as one motored into the Shropshire Gap. All but one that is: the oldest of our tribe, Liveryman Ian Whittle, broke out on minimums (allegedly!) on the ILS, in

his PA28. Good effort, Ian.

We received a warm welcome in the bar of Valley's austere Officers' Mess. A graduation party was in full swing, and with few scheduled to fly the following day there was plenty of fast jet exuberance in evidence. An international flavour was added by some Dutch F16 aircrew from Leeuwarden over for the Families Day the following day.

Our 'work' started the following morning with a briefing by Rob, in the excellent Moran Building - a structure well-liked by those who use it - *"built for business"*. That business is underscored at its entrance by the presence of a Paveway IV drill round - *"we are in the business of air power"*.

The problems caused by the structure of the Military Flying Training System will be well known to many Company Members, and have recently received more publicity. It was clear that Rob and his team have been working very hard to mitigate its deficiencies. Many Members of a certain vintage (and we had a past OC of IV(AC) Sqn, from its Harrier days, in our number) will have been surprised about how the RAF's flying training has developed towards much more of a nurturing environment than the "up or out" culture of yore!

Rob works to a target chop rate of under 10%; indeed it is running at c. 4 students p.a. - less than one per course. The key attribute to make the grade being that a graduate of 4 FTS should be someone with whom one *"feels comfortable going to war with"*. When Rob himself underwent his fast jet training, he was taught under that "Conform or Fail" mentality, and related how in his first mutual air combat sortie, his instructor began the briefing with the uplifting mantra of "(Whatever you do), *I will kill you!*". Rob stressed that in these more enlightened times, firstly the objective is to train the brain and the ethos, and not just the flying; secondly, that the course structure is oriented around getting the most out of every pilot from the top 10%, to the bottom 30% of students. But the upside of a shrinking Air Force is that the quality of the bottom 30% has risen - Rob is *"stunned"* by the quality of all his students. The bottom 30% or so of each course benefit from a much more student-centric approach to teaching.

4 FTS comprises IV (AC) Sqn (which does the Tactical and Weapons training), and its sister unit XXV (F) Sqn which does the first half of the course (i.e. advanced flying training). These are large units: Rob and OC XXV(F) command 110 pilots and 230 engineers between



Who knew that IV Sqn had musicians?!



them, compared to 15 & 200 in an average front-line squadron. These numbers are intended to grow by some 30% over the next two years. Both squadrons have a C Flight which develop its own QFIs. CFS representatives in residence to check standards are maintained.

The key attribute of the Hawk T2, compared to its T1 predecessor, is that it has a glass cockpit, moreover one that can be set up to emulate that of the Typhoon. Hence current Valley graduates do not have to make the huge leap that faced their forebears. The era of high chop rates at the Typhoon OCU, and prolonged courses, is over. The T2's electronics can synthesise most weapons fits of the Typhoon, and indeed most fits of likely enemy types – so 4 FTS can provide its own 'Red Air' for air combat or close air support sorties. The contents of the course are subject to continual evolution arising from input from the 1* Fast Jet Customer Executive Board and the Air Warfare Centre at RAF Waddington.

One result of the closer integration of Hawk training to the Typhoon Force is that some 30-35% of students at Valley come from the International Defence Training programme, i.e. are overseas pilots whose governments have contracted to buy the Typhoon as a package. Having such a large number of students for whom English is not their mother tongue adds another layer of complexity to Rob's job! Given the

The T2 flightline



David Curgven looks relieved the visit is underway!



Rob explains the training in detail

pressure on resources (see below), one might expect that the IDT quotient would have been flexed down, but Whitehall pressures indicate this is unlikely.

Due to the American ITAR (International Traffic in Arms Regulations), we had much less view of the squadron's Desk Top Trainers, and

Flying Training Devices than on previous visits. This arises from the fact that Ascent (the PFI company that operates the MFTS contract) is partly US-owned – it is a joint venture between Lockheed Martin and Babcock. As elsewhere in the RAF, such synthetic devices have become central to the curriculum.

Easily the most impressive part of a very

RAF Valley Families Day



interesting morning was a demonstration by Rob of the mission debriefing procedure. In-flight data collection is so comprehensive that each sortie can be replayed in great detail, from a variety of different views (with the “God’s Eye” perspective appearing to have the most utility, at least for air combat sorties). Rob was the co-author of some of the software. Two-way communication in these debriefs is encouraged. As an aside, Rob pointed out that his students, being of a highly IT literate, video gaming, social media generation, are wont to replay sorties to each other – enhancing the overall peer to peer and wider learning experience.

There has been a well-publicised constraint on flying hours at 4 FTS due to availability of the T2 on the flight line. 28 T2s have been procured; and 15 need to be live on the pan to achieve current objectives, and the actual number has been running significantly lower. We learned that engine availability has been a core problem: too few were procured under the original contract. Moreover it would appear the complex relationship between Defence Equipment & Support (DES), BAeS, Babcock, and the MoD has stress points, with continual downward pressure on costs a common theme.

To sustain the required output, 4 FTS needs to have a complement of 42 students, 46 staff QFIs and 14 student QFIs pa, amounting to 9,200 flying hours. Rob and his colleagues have been honing the course such that targets can be met with approx 7,200 hours and 2 fewer instructors. This would obviously ease the impact of sub-optimal aircraft availability. One hopes that the MoD and DES have learned the painful lessons provided by MFTS to date.

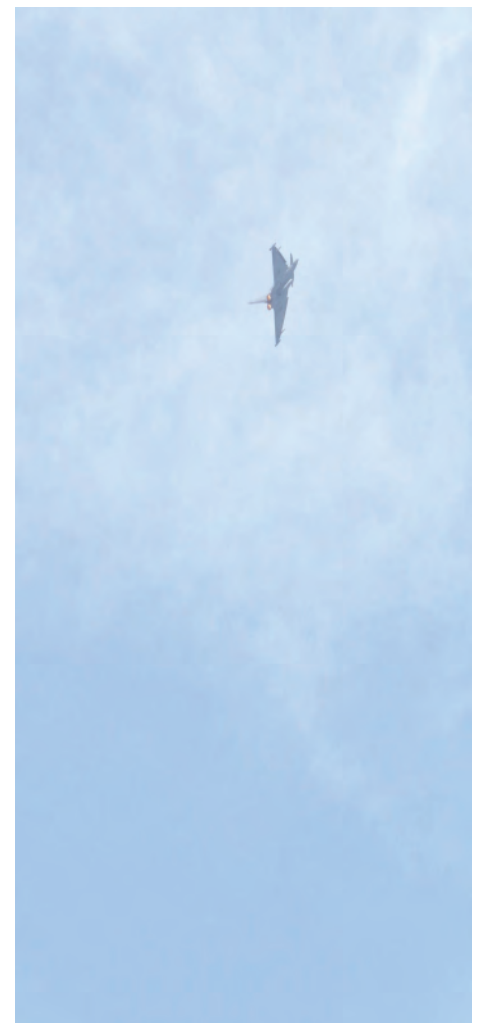
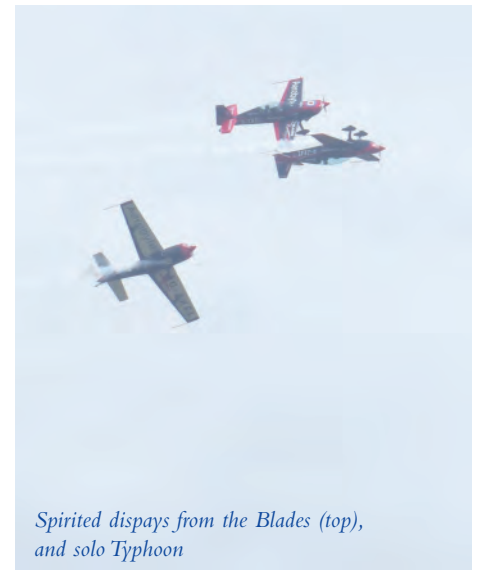
A temporary palliative has been to send the top 10% or so of students (“skimmies”) to fly the Hawk T1 at RAF Leeming with 100 Squadron. This unit has been traditionally used to train Army Joint Tactical Air Controllers, and also provide airborne opposition as required.

It has had to hurriedly equip with some QFIs to conduct the 4 FTS curriculum. Rob assured us that the quality of these students was such that they did not up end up being disadvantaged relative to their colleagues who are flying the more modern equipment.

The final part of the old training system is the Tucano segment, based at RAF Linton on Ouse. This is being replaced within MFTS by the Beechcraft Texan T Mk1, which will also be located at Valley (in the old SAR buildings, for those with long memories). A depressingly few airframes have been procured (10). The main obstacle with the Texan thus far has been incompatibility between survival gear, ejection seat, and cockpit environment. The result has been some initial limitations on overwater flight, although it is hoped that a full release to service will be obtained soon. The first students are scheduled to start their course this September/October.

No doubt there will be further evolution of curricula as the new types bed in: the Prefect (the new elementary trainer, which will be operated out of RAF Cranwell), can cover 80% of the syllabus of the former BFT Tucano course, for example. Some company members were still left wondering at the logic of procuring the Prefect/Texan/HawkT2 trilogy, with such overlaps in performance, and with the Prefect being a relatively complex aircraft on which to carry out initial training. (Aircraft availability of this type has been adversely affected by students over-torquing the engines).

After Rob’s talk we were taken to a hangar to see the T2 in close-up. After lunch in the Sergeants’ Mess we adjourned outside to watch the airshow for Families Day. The solo Typhoon gave a spirited display, but the highlight for the Editor was the Blades – the four-ship team of Extras, all piloted by ex-Red Arrows members. Despite the challenging cross-wind, their flying was such that it is difficult to imagine a more



professional formation piston-engined display.

Thence back to the car for our long slog home. A very enlightening visit, with grateful thanks to Wg Cdr Caine for his tireless enthusiasm and professionalism, and Station Commander Gp Capt Chris Moon (who appeared to be wearing a Welsh dragon on his sleeve, rather than his heart!) for his hospitality.

The state of the UK's Military Flying Training System (MFTS)

By the Editor

Evident to our members who have visited Military Flying Training establishments in the last couple of years, or who have relatives who are young officers in the RAF, MFTS has been showing signs of strain for some while. There have been clearly unacceptable levels of holding between the various stages of flying training. The most extreme appear to be after completion of Initial Officer Training (at RAF Cranwell), and before starting Elementary Flying Training. The Air Force has always had to manage a 'holding' process, and find temporary jobs for such young officers. These jobs have various levels of utility to the individual's future career. The most egregious example to come to the attention of the Editor was a poor lad based at RAF Cosford for up to three years before starting EFT; his role – photocopying for a Sergeant PTI ! How he maintains any semblance of motivation, I do not know.

The causes of this hiatus are several. Perhaps at the nub is the lack of flexibility designed into the system when the MoD decided to devolve the flying training to a Private Finance Initiative. A 25 year PFI contract was awarded to Ascent in 2008, but the student numbers were soon flexed down by SDSR 2010, and the disbandment of the Nimrod and Harrier forces. SDSR 2015 opened the tap again, with the P8 Poseidon contract reawakening a need for maritime crews, and the Foreign Office becoming involved in inserting a need to train foreign students under the International Defence Training scheme

(see the Valley article). Not that IDT revenues stay within the RAF, or even MoD coffers....

The availability of Qualified Flying Instructors is also a pressure point within the current system, albeit that the remedy is more within the RAF's own grasp. Leakage to overseas services appears the main threat.

So apart from a shortage of QFIs, the lack of upward flex at the moment stems from a simple lack of airframes (and in the case of the Hawk T2, spare engines). It is as well to set out the number of airframes procured (it does not take long!): Prefect – 23; Texan T1 – 10; Hawk T2 – 28; Phenom (for multi-engine training) – 5. Technological issues, not unconnected with students over-torquing the turbo-prop engine, have frequently led to only a single Prefect being available for instruction of late!

The lack of flexibility such vanishingly small numbers provide was demonstrated last summer when 2 Phenoms suffered a mid-air collision (allegedly through over-enthusiastic/poorly briefed practice for the RAF 100 flypast), taking out 40% of multi-engine training capacity at a stroke! Possibly as a result of gearing up for the introduction of the Poseidon, a cadre of future multi-engined pilots have had to be shipped out of the MFTS structure to L3, the commercial flight training organisation, which was awarded a three year contract last summer. The approximately 100 RAF students will effectively gain a CPL/IR, and a MCC on their 17 week course. They will also become much

better acquainted with career opportunities as commercial pilots, so it is difficult to see this wheeze helping retention!

The official response to a recent Freedom of Information request revealed that, at that time, there were some 350 officers (from all services) in the flying training system subject to holds, and that the time between completion of IOT and arriving at an OCU for one's first operational tour can be as much as 90 months. This is manifestly unfair on the individuals affected. But it also has ramifications for the RAF down the line. The age at which a Squadron Leader is suitably qualified to be a flight commander, or a Wing Commander to lead a squadron is pushed back. Experience levels in higher ranks will in due course inevitably be reduced. Moreover the Services risk losing a significant proportion of their expensively trained pilots after just one operational tour. Sentient taxpayers cannot be happy about this situation.

One hopes that with a change of Prime Minister, and with a new Minister of Defence who has first-hand experience of the armed forces, the defence budget will rise ever so slightly up the Government's priorities. I am sure any extra funds coming the way of Military Flying Training will be very gratefully applauded by military pilots of every generation.



*Left to right: Prefect, Texan, Hawk T2 and Phenom
Photos courtesy of the RAF*

First Step?

By Liveryman Chris Reynolds

Whilst watching our early evening local BBCTV news programme, BBC Points West, a report made me pay particular attention. The reporter was talking to a 14 year-old boy named Zakoor, who came to this country as a child refugee about four years ago after he, his mother, and sister fled Afghanistan after his father had been taken by the Taliban, never to be seen again.

During the six month overland journey Zakoor became separated from his mother and sister. Zakoor ended up being smuggled into this country in the back of a commercial vehicle only to be abandoned on the hard shoulder of the M5 motorway near Bristol, at night, in pouring rain. He was rescued, in tears, by a passing motorist and taken to a nearby service station where, after being fed, he was handed over to the police. He was aged 10. Subsequently he was placed with a foster family in Bristol and placed in Bedminster Down school to receive education. Bristol, the BBC reported, have taken in the highest number of

child refugees in the country. Zakoor was interviewed along with a teacher from the school. The teacher reported that Zakoor had settled in well and has made extremely good progress both academically and on the sports field and is a very popular pupil with teachers and fellow pupils. When Zakoor was interviewed I noticed the badge on his school jumper looked familiar. It was my old school! He then went on to say that he wished to become either a pilot or engineer. A pilot I thought! I remembered thinking those thoughts at that age. I then remembered how, through the Air Training Corps I first took to the air in a glider from RAF Locking near Weston-Super-Mare. My first experience of powered flight was in the back of a Chipmunk from Filton aerodrome, flying over the newly opened Severn Bridge. How the memories of these initial flights stay with you! I wanted to offer Zakoor an opportunity to start those memories. Now at the age of 14, surely he had been through enough hardship too.

Later that evening I emailed Points West asking them to pass on to Zakoor's foster parents my offer to take him for a flight.

They were delighted at the offer. Eventually we managed to arrange a mutually convenient date. I booked the group's PA22 TriPacer and the flight took place on Sunday 19th May from Oaksey Park airfield (EGTW).

Zakoor had never been in an aircraft before and clearly enjoyed the whole experience. He didn't seem phased by the presence of the cameraman and reporter and took it all in his stride. A very impressive young man!

The BBC suggested that after the flight I might like to make a return visit to my old school and that Zakoor would give me a guided tour. This took place the following week. Needless to say that after leaving this school 52 years ago much had changed. In fact the old school had been knocked down ten years ago and new bigger school had been built in its place.

The report was broadcast on BBC Points West on Tuesday May 28th on their early evening programme. My intention is to offer another flight to Zakoor (this time without the cameraman and reporter giving us instructions), in the hope that it will kindle his enthusiasm for aviation that we as pilots all have and experience.



The Jetstream - a personal reminiscence

Article and photos by Liveryman Tom Eeles

My first encounter with the Handley Page, later the BAe, Jetstream was in 1982, when I found myself suddenly promoted and posted to the Headquarters of Support Command at RAF Brampton, where I became the staff officer responsible for the conduct of fixed wing advanced flying training. This activity covered the work of 4 FTS at RAF Valley using the Hawk, and the Multi Engine Training Squadron (METS) at RAF Finningley, using the Jetstream, an aircraft about which I knew very little. The RAF ordered the Jetstream as a replacement for the Vickers Varsity. It entered service in the early 1970s at CFS and RAF Oakington, but quickly earned a poor reputation, suffering from frequent serious engine failures. The Jetstream fleet was mothballed following a defence review in the 1970s which considerably reduced the size of the RAF's transport fleet, there being consequently a glut of multi-engine pilots. However, by 1982 the fleet had been brought back into service; most were used by METS but some had been transferred to the RN and modified as observer trainers, replacing the Sea Prince.

As a fast jet QFI I knew nothing about multi-engine training, so I soon got myself up to Finningley to get to know this very different aircraft compared to the fast jets that had been my staple for the previous 15 years. Designed as a light commuter airliner and powered by Turbomeca Astazou turbo props, the Jetstream was adequate but certainly not perfect as a trainer. It was never designed to be bashed around the visual circuit on two, or more often, one engine, to be stalled regularly, and generally abused by student pilots. The Astazous never took kindly to the constant power changes associated with flying training. Its stalling characteristics were poor, so a full stick shaker/pusher system was incorporated. However, it was ideal for light transport duties, being pressurised and capable of cruising at a fairly high altitude and moderate speed, but it was rather noisy both inside and out. By 1982 the interior décor had become somewhat shabby and

showed much use of bodge tape to keep bits of it from falling off. There was a rather basic chemical toilet hidden behind a curtain at the rear of the cabin.

After a very swift and scanty conversion I flew a number of sorties as a co-pilot in support of the Red Arrows, much more fun than sitting in a stuffy office at Brampton. My log book reveals six sorties in support of the Reds in July 1983, ranging between Finningley, Scampton, St Mawgan, Liverpool and Valley. More interestingly, I once used a Jetstream to assist in the setting up of Greenham Common as a cruise missile site. The Headquarters at Brampton had responsibility for the security of the site, so to avoid a confrontation with the rather militant female members of the Peace Camp established outside by the main entrance, and to preserve the anonymity of those coming into the site, a Jetstream was used on 25th October to fly security specialists in and out with a degree of secrecy. By now I had been allowed to go solo, so I could now claim first pilot flying hours. My tour at Brampton finished in April 1984 and I returned to the fast jet world, never expecting to sit in a Jetstream again.

Some 3 years later, much to my surprise, I was appointed as OC Examining Wing, CFS, a role once described to me as being the aviation equivalent of having a licence to print money. This appointment required me to be, at a minimum, rated as 'Competent to Instruct' (C to I) on a wide range of training aircraft that included the Jetstream. Thanks to the diligent and skilled instruction of my multi-engine examiner, Sqn Ldr Fred da Costa, I managed to achieve this qualification fairly quickly, and so could undertake the task of examiner, although my knowledge and capability as a Jetstream QFI was fairly basic. As part of this refresher and qualification we took a Jetstream through the Berlin corridor to Gatow - an interesting experience. As we taxied in you could see the Soviet tanks exercising on the other side of the airfield boundary fence. Our departure was delayed by the removal of Rudolf Hess's body back to West Germany by an RAF



C130, an event kept secret at the time to avoid controversy and demonstrations of support from neo-Nazi organisations. I flew the Jetstream regularly with CFS as both QFI and examiner, and ultimately became moderately competent. When I was persuaded by Commandant CFS to attempt an upgrade to A1, one of the many different sorties I was required to do was to teach him the introduction to single engine flying in the Jetstream, which seemed to go well.

The light transport tasks undertaken for CFS by the Jetstream are the ones I remember most. One of the first of these was to take the Commandant CFS and his entourage to Switzerland, on the invitation of the Swiss Air Force, to brief it on the Hawk trainer, which it had just purchased. Sqn Ldr Fred was not available to help with this undertaking, so the crew was Geoff Glover, one of my fast jet examiners, and a distinguished Harrier pilot, who fortuitously was also qualified on the Jetstream, and myself. Neither of us could be considered experts at procedural airways navigation and flying complex holding, arrival and departure procedures, being more used to the freedom of high speed low level flying. Nevertheless we got to Berne without causing any violation to be filed against us, the Jetstream (as far as we could determine) was still serviceable and we enjoyed a few days of excellent flying and Swiss Air Force hospitality.

A slightly jaded Commandant's entourage and crew embarked for the return to the UK, clutching the Swiss Army penknives presented to us by our hosts. No problem with airport security checks in those days. Geoff and I had some difficulty in deciphering the complicated departure procedure from

Berne but in the end managed to get away successfully. Once established in the cruise over France Geoff excused himself from the flight deck for a few minutes to 'go and sort out the impest paperwork'. After quite a while, and now in need of some assistance, I turned around to see him fast asleep in the cabin, along with all the others, leaving me the sole man awake on board. France Control now interrupted with a re-routing demand, which had me totally confused. I managed to bluff my way onward to the FIR boundary without complying with their instructions and we escaped into British airspace and the calm of military radars. Another entertaining task was to route from Scampton to Gloucester to pick up the CFS mascot, a mature and rather grumpy male pelican in its cage, then continue to Northolt to collect three Air Marshals and return all to Scampton for the annual CFS Association Dinner. I recall that the pelican was not a good passenger, nor a well-behaved guest at the Dinner. Fred da Costa and I did get as far as Gibraltar, via Chivenor and Monte Real, in a Jetstream; the excellent earthenware pots I brought back from La Linea are still in use in the garden. We also managed to fly the Jetstream 31, powered by Garret engines, that the RN used for light transport. My final experience concerns an expedition to Berlin in November 1989, when I had major problems with the Jetstream's primitive parking brake, which must have been purchased by Handley Page as a job lot from Ford's Dagenham factory - it looked and functioned exactly like the one in a Ford Popular. This saga is fully documented in 'Out of the Blue, the Final Landing' in the chapter titled 'The Jetstream Parking Brake'. [Editor's note: worth a purchase!]

After two and a half years with CFS I went back to Brampton as Group Captain Flying Training, an appointment that covered all aspects of the RAF's pilot



flying training system up to the point of graduation to an Operational Conversion Unit. Nine months into this tour trouble broke out in the Middle East when Iraq invaded Kuwait. In December 1990 I was tasked to devise a plan whereby teams of medical experts could be shuttled around the country to meet the anticipated incoming aircraft loads of casualties from the land campaign, which had been forecast to be considerable. I planned to use our Jetstream fleet, basing them at Wyton, near Brampton, from where we would run the operation. In the event the plan was never put into operation as the casualty numbers turned out to be much lower than expected. We did, however, use the Jetstream in support of Gulf War 1 by using it to ferry personnel from the Joint Air Reconnaissance and Intelligence Centre (JARIC) to and back from the USAF base at Ramstein, presumably on intelligence-related activities. We never really knew. I did participate as a co-pilot on some of these sorties - another day out of the office - and the Jetstream was ideal for this sort of task. On one occasion, having waited at Ramstein for about 3 hours for our passengers to return with their sacks of material, we set off back to Wyton with a steadily deteriorating forecast of low cloud and fog. When our passengers were advised that a diversion was very likely, and possibly to a civilian airfield, they were extremely unenthusiastic at this prospect, urging us to try and get into a military airfield, most of which by now were closed. We failed to get into Wyton but happily Marham, not far away, was still open and just about in limits. We crept into Marham, put the Jetstream to bed and gratefully accepted Marham's offer of a car to take us back to Brampton. But not our passengers, who decided to wait until their own transport had made its way into Norfolk to collect them, such was the value of their sack loads. These trips to Ramstein were known as Operation Aster.

In 1992 I was appointed as Station Commander at RAF Linton on Ouse. Linton had a close association with the city of York and I got to know its Lord Mayor very well. He was a great character but not a wealthy man, one of a large family, and a crack express steam engine driver in his youth. He told me how one of his brothers had been an air



gunner on a Halifax squadron, but had been declared missing, presumed killed, during the war, one of the many Bomber Command casualties. One day he rang me to tell me that the remains of his brother's aircraft and crew had been discovered in Holland during building work excavation, and that the crew were to be buried with full military honours at the nearest British Commonwealth War Graves cemetery. Unfortunately there was no chance of assisted travel to attend, but could I do anything to help? A quick phone call to my fellow Station Commander down the road at Finningley suddenly produced news of a Jetstream overseas training flight going to somewhere in Holland, there were spare seats - would that be any good? So we were able to get him to his brother's funeral courtesy of the Jetstream and the RAF at a cost he could afford.

Eventually the Beech King Air replaced the Jetstream in RAF service, under a civilian contract to provide the RAF with a multi-engine trainer. This marked the end of an era: ever since its formation in 1918 the RAF had had a Handley Page aircraft in service but this link was finally broken when the Jetstream passed into history and museums. In conclusion, I enjoyed flying the Jetstream despite its idiosyncrasies; it made a complete change from strapping into an ejection seat and rushing around very fast at very low level. However the 'white noise' one experienced on the flight deck from the Astazous and its propellers has undoubtedly contributed to my need to wear hearing aids!

Flying Legends Practice Day

By the Editor, photos by the Editor

It was a stroke of genius (by PM Cliff Spink, I believe) to suggest a few years back that we avail ourselves of the hospitality infrastructure of the Flying Legends air display at Duxford on the Friday before it kicks off in earnest. This gives members an opportunity to enjoy aviation watching in relaxed style, before the maelstrom created by the masses the following day.

Again we were able to use the Friends of the Fighter Collection marquee. A garden party atmosphere ensued. A good number of members showed up, many arriving by air. One nameless member appeared to have invited his whole village to join him.

PM Cliff Spink enlightens John Robinson and PM Chris Spurrier on warbird flying



PM Roger Gault relives past action



Former foes, now in partnership: Me109s and Spitfires on the flight line

The downside of the fact that it is a practice day is that there is no programme, but in my view this means that the rather ad hoc nature of the aerial activity is delightful. There were of course plenty of Spitfires and Hurricanes in evidence. Indeed where else can you see a veritable squadron of the former, and a flight or two of the latter, ranged on the flight line next to a *staffel* of Me109s (or rather Buchons)?! There were outings for the more recent additions to Liveryman John Romain's toybox, his Lysander and Blenheim, which performed a double act.

Arguably the best entertainment of the afternoon was an opposition display by a

Visit organiser (and gatekeeper) David Curgiven



Bearcat and a Martlet; whilst Furies and Sea Furies produced lots of speed, noise, and in most cases, oil.

There was a good selection of C47/DC3s in evidence – remnants no doubt of the gaggle that had battled across the Atlantic for the D-Day 75th anniversary celebrations. As it came time for me to depart, a quartet were about to get airborne for a formation practice.

A very relaxed, and very entertaining day, for which many thanks to David Curgiven.



Lysander & Blenheim make for a rare pair

PM Roger Gault and PM Hugh Field





Smoky Fury



The 2 Seat Sea Fury looks to have consumed rather a lot of oil



Fury tips in



Grumman Bearcat starts an opposition loop



Duxford 2019, not Thorpe Abbots 1943



The SA Bulldog – powerful nostalgia for those of the Editor's vintage



Blenheim levitates



Beautiful wheeler from a C47

Old Warden – the Military Show

By Assistant Richie Piper

The recent Shuttleworth Military Show (previously known as the Military Pageant) has continued the success of over the last few years. A full programme exploited the collection's own aircraft together with guest aircraft. The key focus for this show was to be the largest gathering of Hawker Hurricanes since 1946 which saw half the world's airworthy Hurricanes gather.

The original plan was to have 8 Hurricanes but unfortunately one of the BBMF aircraft was awaiting a new tailwheel. The excitement built throughout the day as the two resident Hurricanes were joined by others that flew in during the show from other airshows. With the arrival of the final two from displaying at Headcorn, the line-up was complete. A nice touch was that Battle of Britain veteran Archie McGinnis was driven by Willy's Jeep along the crowd line to applause as he visited the Hurricane he once flew.

Meanwhile the airshow delivered that unique Old Warden mix with particular favourites such as the Bristol Bulldog, Sopwith Triplane and Camel, Lysander and two Avro 504Ks (one belonging to Alliot Verdon Roe's grandson Eric).

There was also a modern display of the Royal Jordanian Falcons with 4 Extra 300 LXs, with the mysterious sound of Jordanian music playing across the Bedfordshire countryside as they performed. A very tight formation display culminated in a punchy rejoin by the solo aircraft from a tumble at the end. Other visitors were the P-47 "Jug" Nellie (which landed on) and the B17 "Sally B2".

However, everyone's eyes had been feasting on the Hurricanes parked up on the centre of the crowd line. Shuttleworth's own Sea Hurricane 1B Z7015 with resident Mark 1 P3717 together with the BBMF's own Mark IIc PZ856 ("The last of the Many" although currently painted as HW840) and Mark I P2902 all started together. Three of them excluding the BBMF aircraft then taxied to line up as the first vic to stream take off. The BBMF machine would be tail end Charlie.

The final three aircraft comprised of Mark 1 R4118 (the only Battle of Britain Hurricane still flying), the HAC's Mark XXIIa 5711 (but since 2015 painted as the Mark I P3700 as a tribute to the Polish 303 Squadron) and Mark IV 7497

started and taxied to line up as the second vic.

All 7 aircraft took off in stream before heading north to form up. From a wide downwind position to two vics and singleton were closing up ready for the starboard turn to perform a single flypast of seven. The BBMF aircraft broke off to perform a solo display before the remaining 6 did a fly past before breaking up in two separate vics. Each vic did a flypast before breaking into a tailchase to fully satiate the crowd.

The Merlin sound in a Hurricane is perhaps a little smother with a greater bass, and the flightpath is perhaps a little more sedate than the Spitfire but full of grace. As the Hurricanes landed, the crowd awoke from the spell and gave warm hearted applause for the unique experience.

As final treat, as the wind was so light, a number of Edwardians flew with the Bristol Boxkite, Blackburn Monoplane Type 'D', and finally the Avro Triplane gracing the skies. The main use of rudder for turns rather bank, and the translucent wings as the sun shone on the linen covered wings, showed the delicate nature of pre-WW1 aircraft. It is a remarkable feat that aviation advanced so quickly to deliver the Hurricane and Spitfire in less than 25 years.

