ROYAL AIR FORCE

HISTORICAL SOCIETY

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ROYAL AIR FORCE HISTORICAL SOCIETY

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SELECTED GLOSSARY

A&AEE	Aeroplane and Armament Experimental Establishment
AM	Air Ministry
BAWA	Bristol Aerospace Welfare Association
BPC	British Purchasing Commission
CBC	Canadian Broadcasting Corporation
CFE	Central Fighter Establishment
CIA	(US) Central Intelligence Agency
CMB	Coastal Motor Boat
COIN	Counter Insurgency
DCA	Director of Civil Aviation
ETPS	Empire Test Pilots' School
GAO	(US) Government Accountability Office
GPO	General Post Office
IISS	International Institute for Strategic Studies
ISA	Intelligence, Surveillance and Acquisition
ISR	Intelligence, Surveillance and Reconnaissance
JSCSC	Joint Service Command and Staff College
MAP	Ministry of Aircraft Production
NSD	'Nothing special doing'
QRA	Quick Reaction Alert
RAFM	Royal Air Force Museum
RPAS	Remotely Piloted Air Systems
R-R	Rolls-Royce
SEAD	Suppression of Enemy Air Defences
TACEVAL	Tactical Evaluation
TG	Trade Group
TNA	The National Archives
TWU	Tactical Weapons Unit
UAS	Unmanned Air Systems
UAV	Unmanned Aerial Vehicle
UCAV	Unmanned Combat Aerial Vehicle

POST-WAR FIGHTER SQUADRON MARKINGS

In 2006 this Society published an essay on *The Origins Of Fighter Squadron Heraldry* which discussed the evolution of the colourful markings worn by RAF fighters during the inter-war years.[1] In 1938 these were obliterated by a coat of camouflage paint with each squadron subsequently being identified by a two-letter code. This system remained in use throughout WW II and for the next five years. From 1946, however, squadrons were permitted to display their badge (no more than 18" tall) and by 1947 some had begun to re-instate their pre-war colours, sometimes in a quite flamboyant fashion. Such overt displays were short-lived, but the authorities were inclined to tolerate very small reproductions of pre-war style 'bars' flanking the squadron badge; these were not applied universally but by 1948 they had begun to appear on, for instance, the noses or engine nacelles of Meteors.

By mid-1950, some squadrons had begun to display full-scale bar markings flanking the fuselage roundel. This soon became commonplace and the use of code letters was formally abandoned in January 1951. By that time, the Air Ministry had (probably) already published a set of diagrams illustrating all of the officially approved bar markings.[2] This was superseded in 1955 by an edict which covered representations of the 'Second Series' of markings. This included units which had not previously operated in the fighter role and thus introduced many new variations on the theme. With a few later additions, these have been the standard fighter markings ever since, although the size of today's RAF means that few remain in use.

Alan Carlaw who, along with Dugald Cameron, started the *Squadron Prints* enterprise in 1977, has always been interested in badges and markings. He has recently put together a collection of all of the post-WW II fighter squadron markings (plus some later 'squadron-style' markings) which he has illustrated flanking the unit emblem, along with its heraldic description and motto. He has very generously made these available to members of the Society.

CGJ

1 Journal 36, pp52-66.

2 The Air Ministry letter in question, C.34842/47 of 20 October 1950, has proved elusive but there may be a copy buried in a file at Kew. If anyone comes across it, the Editor would be most grateful for the TNA reference. **Ed**

Our Guest Speaker at the RAF Club, following the Society's Annual General Meeting on 18 June 2014 was the

Director General Royal Air Force Museum

Air Vice-Marshal Dr Peter Dye

whose topic was:

COMMEMORATING THE FIRST WAR IN THE AIR

My aim this evening is to explain how the Royal Air Force Museum (RAFM) plans to tell the story of air power in the First World War – as part of the wider national programme to commemorate the centenary over the 2014-2018 period. This includes, of course, the Centenary of the Royal Air Force. We have consciously selected this December for the unveiling of our new exhibition, partly to de-conflict with the opening of the refurbished Imperial War Museum galleries but also to give us sufficient time to do the subject justice. As you will hear, we have chosen a very different approach to the exhibition that involves a more inclusive and detailed planning process and an extended period of development. I would stress that this is not a revolutionary step for the RAFM. Indeed, it builds on the success of the National Cold War Exhibition at Cosford that presents a broad narrative, incorporating small as well as large objects, and addresses the impact on individuals as much as on nations.

The RAFM exists to tell the story of the Royal Air Force through its people and collections. We have three core aims. For our visitors, we make our collections and the RAF story relevant and stimulating. For current and former RAF personnel and their families, we preserve, honour and share the stories of their service. For our nation, we help people to understand the impact of the RAF on the world.

When the Museum opened in 1972 its collection comprised just 40 aircraft exhibited in four converted hangars at Hendon. Since then, the collection has grown to 500,000 artefacts including over 200 aircraft exhibited on two major sites (Hendon and Cosford) comprising historic hangars, newly-designed buildings and a dedicated conservation centre.

Visitor experience is central to achieving our aims. This coming year we hope to attract nearly 800,000 individual visitors but we can only sustain this level of performance by continuous effort in what is

The recovery of the last surviving Do 17 provided the Museum with a great deal of publicity.

an increasingly competitive marketplace. We have been able to grow our audience by introducing a wider range of events – including film shows, model making and sports demonstrations – introducing a regular programme of temporary exhibitions – such as 'Pilots of the Caribbean' and 'Brothers in Arms' (on the Polish contribution to the RAF in the Second World War) – and by developing our national and international profile. The salvage last year of the world's last surviving Dornier Do 17 bomber is just one example of how we have raised awareness of the RAFM – while also saving an unique object for the nation. Greater national and international collaboration, such as the loan of the last Hawker Typhoon to Canada this June in support of their D-Day and National commemorations, has also had a significant impact. Of course, such major projects are infrequent, but we have had equal success in getting large numbers of young people into the museum, through youth organizations – such as the Air Cadets and Scouts – and our formal schools programme that now exceeds 40,000 students each year across both sites.

In planning for our new First World War exhibition we were

conscious that we have one of the best, if not *the* best, collection of aircraft and artefacts from the period. We also have the advantage of being based on an original First World War (actually pre-First World War) airfield with several original buildings. We were also conscious that the exhibition could not be separated from the RAF's centenary in 2018. After all, it was the huge advances in aviation and the achievements of Royal Flying Corps and Royal Naval Air Service personnel in all theatres of war, that led to the creation of the world's first independent air service.

We have structured our plans around four themes: Commemorate; Celebrate; Communicate and Connect. I venture to suggest that the first two are relatively straightforward to define (and to achieve). On the other hand, how we communicate with our audience and how we connect with them is a major (and enduring) challenge. Our focus will be on sharing stories through activity programmes and digital technology that stimulate enquiry. As a result, we hope that we can connect with a much wider audience than has traditionally been the case, involving volunteers, apprentices and members of the local community to a much greater extent. We are determined that the exhibition should reach the wider constituency – that reflects modern Britain and the diverse world we live in.

The First World War exhibition forms just one element in the RAF's 100 year story. We have chosen to approach this narrative by creating six 'chapters', as follows:

- ***Early Aviation/First World War***
- ***Inter-War***
- ***Second World War***
- ***Cold War***
- ***Contemporary (Falklands to Libya)***
- ***Now & Future***

This is likely to require significant re-organisation and refurbishment of both sites (London and Hendon) over the next decade. The anchor for these efforts will be the First World War exhibition in the Grahame-White Factory and Watch Tower at Hendon. These (conjoined) buildings provide a direct link to the

The Grahame-White Factory and Watch Tower provide a unique and enduring link to the past and an ideal site for mounting the core of the First War in the Air Exhibition.

origins of British military aviation as well as the hugely expensive industrial effort required to supply aircraft and other munitions during the First World War. The social and political upheaval that this represented is as central to the story as is the immense progress made in aviation technology over the four years of conflict.

From the very beginning, we were determined to involve as many staff as possible in creating the new exhibition. Curatorial, Archives, Conservation, Engineering, Access & Learning, Corporate, Operations and Retail were all recruited to the effort. We created a series of multidisciplinary teams to progress the work under a dedicated project manager. The first step for all the teams was to understand their audience – based on independent research across all demographics. In some ways this was reassuring as it demonstrated a high level of public knowledge regarding some aspects but it also revealed the rather depressing fact that many individuals only knew there had been a First World War because they had heard of the Second World War and therefore deduced that there must have been a ‘first’. This feedback was supported by focus groups, surveys and inviting a public vote on the 100 ‘best objects’ that might feature in the exhibition. The overwhelming consensus – across all groups including specialists and veterans – was that we needed to place the human being at the centre of the exhibition. It was stressed that what individuals and families

most wanted was to understand the experience of individuals – whether in the air or on the ground, whether at home or overseas and whether in a factory or in the frontline.

In parallel with this effort, we have embarked on the process of transforming not only how we go about creating an exhibition but also the role of the museum's staff in this process. I have mentioned the direct involvement of all the functional areas. It is our hope that this will create the foundation for a more inclusive and dynamic approach to future exhibitions – both permanent and temporary – drawing on the strengths and valuable experience of all staff and a much-expanded volunteer base. In summary, our aim has been to place the audience at the heart of the exhibition and to involve them in the experience of actual participants by drawing on the rich diversity of our collections and using a range of techniques to tell their stories.

None of this is intended to disguise or otherwise obscure the impact of air power on the post-war world and the future of warfare. Key themes in the narrative include:

- *The rapidly increasing importance of military aviation during the war.*
- *Air forces grew exponentially as aircraft roles increased and capabilities grew.*
- *Their most important contribution was cooperation with ground forces and the direction of accurate, predicted, indirect artillery fire.*
- *Air power depended on achieving air superiority.*
- *Air superiority was a competitive and fragile state.*
- *Sustaining air superiority demanded an increasing share of national resources.*
- *The majority of RFC personnel (over 80%) were employed in support activities.*
- *High technical skills, motorisation and a ready supply of spares and replacement aircraft were vital ingredients.*
- *A large ground and flying training organisation was also an essential pre-requisite.*
- *The industrial, economic and political changes required to produce increasing quantities of munitions (and aircraft) transformed the management of warfare.*

The WW I Exhibition will acknowledge that the vast majority of RFC personnel were employed in support activities.

- *These changes also affected post-war society.*
- *The potential for air power to undertake strategic operations (including bombing the enemy's homeland) was first demonstrated during the First World War.*
- *The creation of the Royal Air Force in 1918, the world's first independent air force, was the most significant and enduring legacy of the 'First War In The Air'.*
- *The principles established in the First World War continue to underpin the delivery of air power.*

To focus the narrative, these 'lessons' were distilled into the phrase 'He who controls the air, controls the battlefield.' However, our exhibition team needed something a little less cryptic, and a little more descriptive, so we came up with the following statement that has been used as their reference in designing the exhibition elements:

> Control of the air is essential to all military activities at sea and on land. This relationship was first defined during the First World War by the effort of thousands of men and women experimenting with cutting-edge technologies.

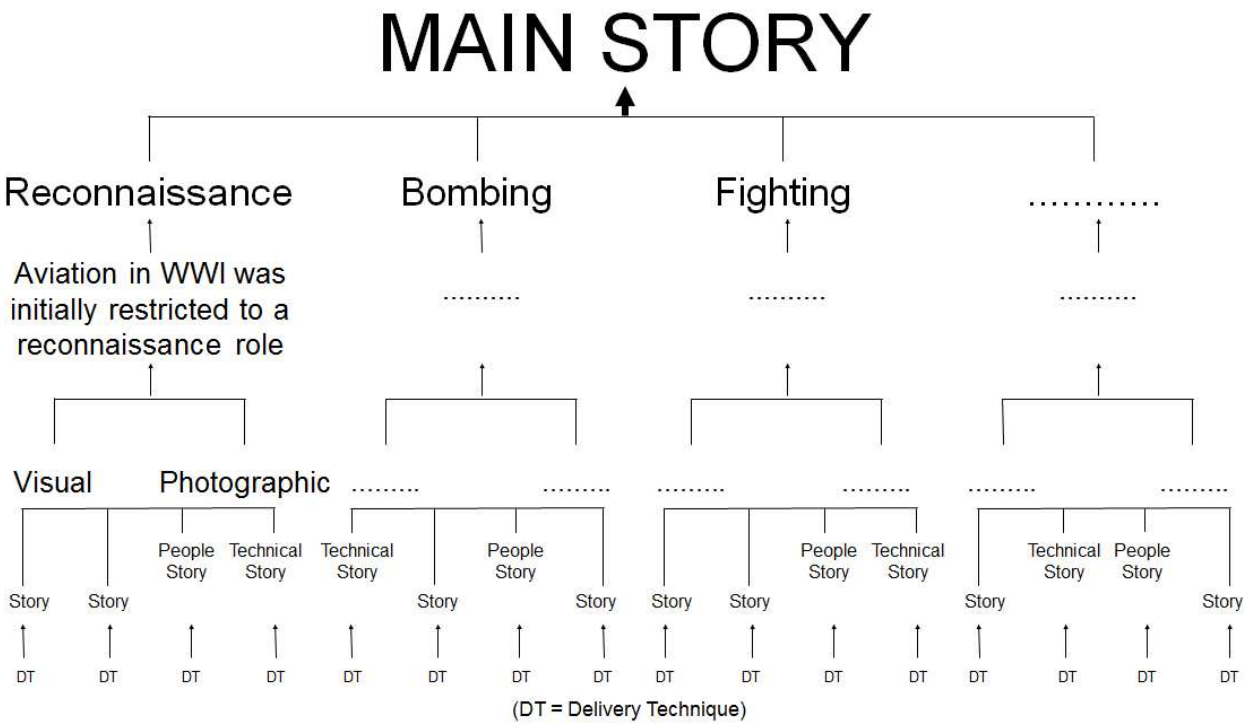
If nothing else, we want our visitors to go away from the exhibition understanding this message. To help them to do so, the narrative has

been structured around five elements: People; Technologies; Place; Circumstances; Actions & Impact. This will provide a consistent theme through the exhibition while ensuring the audience – although sensitive to the experience of individual participants – never loses sight of the wider picture. The detailed design process has been broken down in to five steps:

- *Define a story*
- *Analyse its components*
- *Create a narrative structure*
- *Define the key design elements*
- *Define thematic chapters*
- *Develop a narrative hierarchy*
- *Consider assets and techniques*

This is best explained by briefly considering an actual example. Aviation in the First World War was initially restricted to reconnaissance. The two aspects of reconnaissance (visual and photographic) can be illustrated through a series of supporting stories built around the technologies and people involved. There are a variety of techniques that can be employed (film, audio, text, images, etc). Each story, and indeed each level of the hierarchy, requires a delivery technique that engages with the audience and ensures they take away the desired understanding. Techniques may be as simple as an object and a graphic panel, or as complex as an immersive interactive media piece. These threads have then to be drawn together to allow the visitor to understand the impact on the war and how this evolved over time. Our current plan is to employ several large flat panels illustrating the contribution of aerial reconnaissance (including map making, artillery spotting and contact patrols) during key battles such as the Somme, Third Ypres and Amiens. If this can be made an interactive process, so much the better, but the most important thing is to ensure that our visitors understand and remember.

Although the interior of the Grahame-White Factory offers a great deal of space, it is not all usable unless some major changes are made. We have therefore decided to suspend some aircraft and to make more use of the end-offices that have largely stood empty since the building was opened in 2003. We have also agreed to create a single entrance and exit to allow a circular flow through the exhibition. This will be

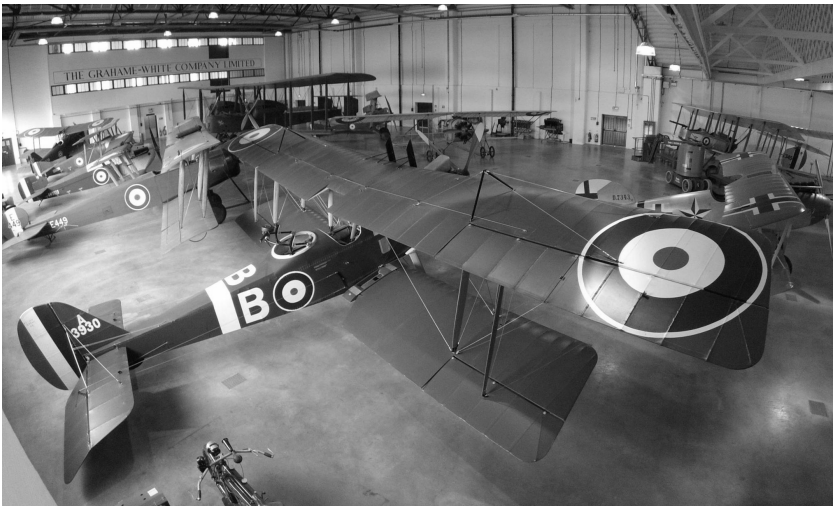


Schematic illustrating the five-step design process which needs to be followed for each topic.

achieved by creating a series of thematic areas and narrative panels that will guide the visitor, starting with a clearly defined entrance that will signposted and landscaped to facilitate public access from the main car park. At present, somewhat less than 10% of our visitors find their way to the Grahame-White Factory. Finally, we will also make provision for a series of temporary exhibitions, involving local organisations and schools, to sustain the exhibition's 'freshness' and public interest.

So where are we today? The good news is that we have over £750,000 of funding from the Lottery. We hope to attract further sponsorship but even with existing funds we have a budget close to £1.5m. This has allowed us to appoint a WW I Education Officer who is already developing our schools programme for the next four years. We have also recruited two Volunteer Managers who will lead the increased volunteer effort at both of our sites, focusing initially on the First World War. Activity plans are in hand as is an extensive events programme. We are also working with a number of academic and media partners, including Birmingham, Exeter and Middlesex Universities on temporary exhibitions and wider public engagement, including the Massive On-line Open Course (MOOC) – 'Wings of Modernity'. Finally, we are looking to work with a number of international partners, including the National Air & Space Museum, the Canadian Air & Space Museum and the *Musee de l'Air*, to create collaborative programmes over the four years of the centenary.

In terms of the immediate timeline, the necessary aircraft moves have started, including the move of the Vickers Vimy to temporary store and the reallocation of three First World War aircraft to Cosford (for their parallel exhibition). Work is in hand on an exhibition catalogue that will develop the stories behind individual artefacts in the exhibition. I am grateful to the numerous authors who have given their personal time to this effort. We have introduced a number of advance projects (such as the new 'Biggles & Chums' art exhibition in the Hendon Art Gallery and a World War One Film Season curated by Sir Peter Jackson. We are also looking to mobilise a number of restoration projects that will engage volunteers and apprentices including our two RAF Leyland 3-ton lorries and the creation of an airship control car based on an original currently held by the *Musee de l'Air*. Landscaping will start soon as will the internal engineering



The interior of the Factory which will house the core of the Exhibition, with several aircraft suspended from the ceiling to create space for displays on the ground.

changes to allow aircraft to be suspended in the Grahame-White Factory. Everything is on schedule, therefore, for the formal opening on 2 December 2014. I am certain that this will be achieved and I look forward to welcoming you to what will be, in my opinion, a fitting tribute to those men and women of the Royal Flying Corps, Royal Naval Air Service and Royal Air Force who sacrificed so much and worked tirelessly in defence of their nation and transformed the world for all nations. I can think of no better way to commemorate and celebrate the start of the Royal Air Force's second century.

DISCUSSION

Sqn Ldr Bob Hall: While I was doing some ATC work with the Reserve Forces' and Cadets' Association in Greater London recently I discovered that they have created a fictitious individual, whom they have put on Facebook. He is going to join the Army and the events of WW I will be reflected in his and his family's experiences over the next four years. I understand, for instance, that he is going to have a brother who is a conscientious objector, a relative who is an officer, another who is sent to Gallipoli and so on. This particular project is focused on the Army Reserve – the old TA – and, specifically, the London Regiment, but something similar could be done for the Royal Air Force – and exploiting Facebook would cover the whole country, not just the areas relatively close to the two museums.

AVM Peter Dye: Thank you for that. A 'virtual' approach is indeed an option, and the RAF Museum does make information available digitally. But I think that is for the Royal Air Force, rather than the Museum, to decide how they want to do this. I have no problem with providing, indeed we already do provide, information on RAF careers within the Museum – and we relate that to current issues – like the relevance of drones. The Museum provides an ideal opportunity for the Royal Air Force to engage with the public and to examine contemporary issues. We already provide a foundation for developments of that nature and I would not be opposed to extending it in the direction that you describe, but there is only so much that the Museum can do and we do have to focus our efforts and resources. But, given that we are funded by the Ministry of Defence, I think it only reasonable that they should feel able to ask us to help in explaining what the armed forces are doing today – and what went before.

Wg Cdr Jeff Jefford: I noticed, among the aeroplanes displayed in one of your mock-ups of the Grahame-White hangar, that there was a Nieuport and a Fokker D.VIII. Are you hoping to import some aeroplanes, or was that artistic licence?

Dye: No – artistic licence, I'm afraid. The designers will have used whatever generic images came readily to hand – that we didn't have to pay for! When it comes to hardware, we can only display what we

have got – there are no surprises in store.

Stephen Mason: Two questions, if I may. First – you mentioned links to academic institutions. To what extent are you linking with the IWM, and the National Army Museum – when it reopens – in terms of cross-coverage. My second question – I have a particular interest in music services. Are you planning, either at the Museum itself, or perhaps in connection with the opening of specific displays, to get the music services involved, because that is one of the ways in which the RAF is actually seen around the country.

Dye: The IWM has the overall lead on the heritage/historical side of the centenary and they are well aware of what we are doing. But they are quite busy – they have a huge tapestry to cover – and liaison has largely been to do with deconflicting events, in terms of the month in which they will be mounted, or opened. The 4th of August is obviously *the* day this year, but everything can't happen then, which is why our Exhibition is opening in December. But commemorating 1914 itself is relatively straightforward; the real challenge, for all the museums, is 'What are you going to do in 2015, 2016 and so on?' Our programme allows us to refresh our displays. So, we are working with IWM, but its role has been co-ordination and deconflication and making source material available, not just to the major museums, but to the many smaller groups and institutions who are undertaking WW I-related projects.

In terms of music – there are two ways of answering that. There will be a sound dimension to the exhibition, including the popular music of the period and one of the sections of the catalogue will be devoted to the 'entertainment' of airmen – what they did while off-duty. There is a very rich and entertaining story there in terms of squadron ensembles, concert parties and the like. Our aim will be to try to reflect what it was like to be a member of British society at that time. In terms of the formal engagement of the music services. That is something that still needs to be talked through but next month, for instance, we have an exhibition focused on the Royal Air Force and the Royal Air Force of Oman and that will involve musical contributions from both air forces.

Air Mshl Sir Freddie Sowrey: You have three stories to tell. First,

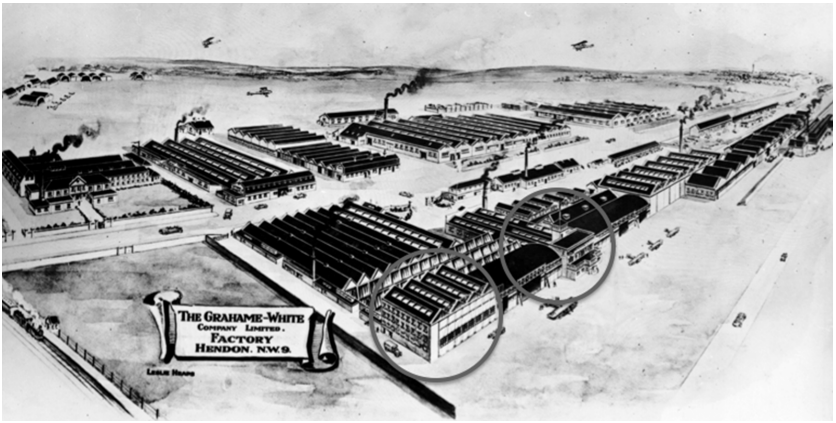
there's the Royal Flying Corps, then the formation of the Royal Air Force – in war – and finally you have the war itself and the continuity of the 100 years since then. Do you reckon that, by covering all of that, people will simply take out of it what they want, or do you hope to persuade them to explore new avenues of which they had not previously been aware?

Dye: That is a really difficult question to answer. The problem is the sheer complexity of air warfare and the remarkable changes – not least technical advances – that it has embraced. There is, for instance, enough material for us to be able to devote the whole exhibition to just the Battle of Amiens, but we have to cover the rest of the Western Front and the war in other theatres and at sea – and that's just WW I. It's a question of depth of focus, too deep and the topic becomes specialised, too wide and it becomes superficial. So our designers are aiming to concentrate on some key issues, while trying to avoid complexity. It's a balancing act, and it's a really difficult one but we do hope to guide our visitors and perhaps encourage them to dig deeper themselves. The problem is complicated by the nature of the audience. For instance, the influence of inter-Service rivalry on the creation, and subsequent development, of the air services is a really interesting topic which some might find engrossing, but its nuances would surely be lost on a group of school children.

I don't feel that I have really answered your question, and I'm not sure that I can. Different visitors need to be told appropriate stories. There are so many facets to three-dimensional warfare, always conducted at the leading edge of technology, that striking the right balance is a real challenge – and, I think, not one that is faced by some of the other Service museums, or at least, not to the same extent.

Air Cdre Graham Pitchfork: Most people tend to think that the First World War was fought overseas, but German bombing meant that it did actually involve people at home – especially here in London. Are you going to remind people of that?

Dye: Yes. I didn't really talk about it, but the Home Front is a topic in itself. In that context, mounting the exhibition at Hendon is particularly appropriate. It was a major focus of pre-war aviation activity, including the Grahame-White factory. Aircraft production



The extent of the Grahame-White factory in WW I, with the two surviving buildings circled.

continued throughout the war, while the airfield became a training facility for naval aviators. There were many other airfields around London, and there was the bombing, of course. We will be devoting some space to that but the main focus will, inevitably, be on combat and, in particular, the Western Front, and I make no apology for that.

The social and political dimensions of the Home Front are really interesting. There were other major productions centres in and around London, close to Hendon there was Airco at the Hyde and Handley Page at Cricklewood, both on the Edgware Road and, a little further out, Vickers and Martinsyde at Brooklands, Sopwith at Kingston and so on. Most of that, in fact, all of it, has gone now and one of our ongoing tasks is to remind the residents of Colindale of what used to happen in and around Hendon. Furthermore, my picture of the Grahame-White factory, 80% of its staff women – supplemented by the odd tea boy, as yet too young, and a few men too old or unfit, for active service – says a lot about the transformation of British society in terms of suffrage. It would be easy to get carried away with this, but these were developments that continue to have an impact today.

Adam Sutch: In terms of 'where you want to get to', do you think that in ten years' time your logo will still say 'RAF Museum' or will you have become an 'interpretation centre' or some such?

Dye: There is something slightly tyrannical in being the museum of a

living organisation – because the Royal Air Force generates new 'history' every day. It isn't entirely fair to compare us with the British Museum, of course, but the fact is that they don't have to keep up with the ongoing story of the Hittite Empire! We have an obligation to capture and secure the history of the RAF, as it happens, and it is rewarding to be associated with a living entity. That said, it would make my – and the Trustees' – lives a lot easier if there weren't always new aeroplanes and artefacts to acquire, store and preserve, because we are, in effect, on a treadmill! But, even if the RAF were to cease to exist at some stage – and I'm sure that it won't – we already have more than enough documented history to sustain the Museum, in more or less its current form, indefinitely.

Al Pollock: I would like to draw attention to the importance of one of the 'other' fronts – East Africa. I am sure that you will be aware, although many air marshals are not, that No 26 Sqn fought there. This is significant for two reasons. First because it was the first Dominion squadron and secondly because the campaign was overseen by Jan Smuts during 1916 and it is arguable, therefore, that it was his experience of air power in East Africa that would, a year later, provide the inspiration for the pivotal reports that he wrote and which led to the creation of the Royal Air Force in 1918.

Dye: There is something in that, but the RFC participated in other comparatively remote regions that attract relatively little attention, compared to the Western Front – Italy, Palestine and Macedonia, of course, but some other quite surprising places – India, Aden, even Russia, both North and South. I acknowledge the contribution of No 26 Sqn, but I would also point out that it was actually the RNAS who were there first. We will be touching on this in the Exhibition and the catalogue will include a piece on aviation in East Africa that I shall be contributing personally. Just how much influence that really had on Smuts is, I think, debatable, but there will be some mention of both No 8 Naval Sqn and No 26 Sqn in East Africa, along with the other less publicised theatres to make the point that WW I really was a *global* war. In aviation terms, the war of 1939-45 was on a much larger scale, of course, but the foundations on which it was fought had been laid between 1914 and 1919.

SUMMARY OF THE MINUTES OF THE TWENTY-EIGHTH ANNUAL GENERAL MEETING HELD IN THE ROYAL AIR FORCE CLUB ON 18 JUNE 2014

Chairman's Report.

AVM Baldwin, Chairman, noted with sadness the passing of Desmond Goch and Dr Jack Dunham both of whom had served the Society and the Committee for many years.

The most recent Journal, No 58, recorded the 2013 AGM and Professor Richard Morris's address on 'Bomber Command in Popular Literature and Perception' and the lively discussions that followed. The autumn seminar, held at the BAWA, Bristol, examined the Vulcan in RAF service, culminating in a report on the last flying example, XH558. Some 186 members and guests attended – a record audience for this very successful event under the chairmanship of Sir Michael Knight. In the spring, General Sir Rupert Smith chaired a seminar at the RAF Museum, Hendon, entitled 'The RAF and Airborne Forces'. This too was most successful, and attracted a number of Army visitors.

The autumn 2014 seminar, to be held on Wednesday 22 October at Hendon, would look at 'The Far East Air Force: a Post War Study'.

The finances of the Society continued to be healthy, with a balance of some £26,000 at the end of 2013. The Society would continue to subsidize seminar attendance, maintaining the cost at £20 per head, and membership would be unchanged at £18 per annum. The Society's website had been extensively revised and improved on the initiative of Wg Cdr Steve Chappell, a new committee member. Much work had been completed to improve on-line access to Journals, all of which up to No 48 were now available. Concluding, the Chairman thanked the Committee for their continued hard work, and expressed his appreciation of the wise support and encouragement of the President, Sir Michael Beetham, and the Vice-President, Sir Frederick Sowrey.

Secretary's Report.

Gp Capt Dearman, Secretary, reported that since the last AGM, seventeen new members had joined and some fourteen had lapsed leaving total membership at around 690. The Society had awarded a

Henry Probert Bursary to Miss L Wilkinson to assist her studies of Reserve Forces.

Treasurer's Report.

Mr Boyes, Treasurer, had submitted the 2013 accounts and his written report. The financial year 2012 had shown a small surplus of £637, close to the loss incurred in 2012. Membership was more stable than might have been feared, with subscription income falling only slightly. The support of industry to the Bristol seminar had provided a welcome offset to the cost of seminars. Nevertheless, investment income continued to be minimal, but Gift Aid provided a useful increment to income. Overall, the financial position remained satisfactory.

The Society's income had fallen below the Charity Commission threshold for a formal audit requirement. Accordingly, J R Auber had stood down as the Society's auditor and Mr Bryan Rogers had offered to be nominated as Independent Examiner. A proposal by Gp Capt Heron, seconded by Wg Cdr Chappell, that the accounts be accepted and that Mr Bryan Rogers be appointed Independent Examiner was carried.

Constitution.

Since the Society's constitution provided, specifically, for an annual audit it required amendment to permit independent examination. The Editor had tabled and circulated a suitable draft amendment. Proposed by Mr Cox and seconded by Wg Cdr Cummings, the amendment was carried.

Appointment of Executive Committee.

The Chairman noted that Wg Cdr D Stewart, an ex-officio committee member from the JSCSC, had been posted as OC 47 Sqn, and no replacement in his former post had arrived. An invitation would be extended to his successor in due course. The remaining executive committee members had offered themselves for re-election with Wg Cdr C J Cummings taking on the role of Membership Secretary vice the late Dr Dunham. Gp Capt Paul Wilkins had succeeded Gp Capt Squires as DDefS(RAF) and had agreed to be an ex-officio member of the committee. A proposal by Sir Frederick Sowrey, seconded by Air Cdre Tyack, that the President, MRAF Sir

Michael Beetham and all members be elected was carried. The executive committee members so elected were:

AVM N B Baldwin CB CBE	Chairman
Gp Capt J D Heron OBE	Vice-Chairman
Gp Capt K J Dearman FRAeS	Secretary
Wg Cdr C J Cummings	Membership Secretary
Mr J Boyes TD CA	Treasurer
Wg Cdr C G Jefford MBE BA	Editor & Pubs Manager
Air Cdre G R Pitchfork MBE MA FRAeS	
Wg Cdr S Chappell MA MSc RAF	

The *ex-officio* members of the committee were:

J S Cox BA MA	Head of AHB
AVM P Dye OBE BSc(Eng) CEng ACGI MRAeS	DG RAF Museum
Gp Capt P Wilkins MA RAF	DDefS(RAF)

Discussion.

Mr J Beatty asked about plans to mark the centenary of the RAF and of the RNAS and RFC. Gp Capt Wilkins outlined the RAF's plans for the centenary, noting that they hoped to draw on the resources of the Society. Mr P Beevor noted that between 11 and 13 Aug, two BE2c aircraft would fly to St Omer to celebrate the first Channel crossing by operational aircraft. A celebration would take place at Dover on 13 Aug.

Two Air Forces Award.

Air Mshl Sir Frederick Sowrey, Vice-President of the Society, concluded the AGM by presenting the Two Air Forces Award to Sqn Ldr J Doyle for his paper on UAVs.

In 1996 the Royal Air Force Historical Society established, in collaboration with its American sister organisation, the Air Force Historical Foundation, the Two Air Forces Award, which was to be presented annually on each side of the Atlantic in recognition of outstanding academic work by a serving officer or airman. It is intended to reproduce some of these papers from time to time in the Journal. This one was the winning RAF submission in 2013. ***Ed***

RISE OF THE ROBOTS? WESTERN UNMANNED AIR OPERATIONS IN IRAQ AND AFGHANISTAN, 2001 TO 2010

by Squadron Leader Joe Doyle

This article questions the extent to which the military unmanned aerial vehicle (UAV), for several decades a *developing* technology of potentially huge significance, matured in the aftermath of the 9/11 attacks on the US into an *established* technology that might compete with or even replace its manned contemporaries.[1] This question lies within a broader theme; whether or not a recent 'rise of the robots' has constituted a broad revolution in warfare that will fundamentally change the nature of military air power, and perhaps even the role of the human being as a direct and vulnerable participant in military conflict.

In fact, military UAVs did *not* show themselves to be genuine competitors to conventional manned aircraft between 2001 and 2010. Success in mission areas where UAV utility was most evident was enabled by a counterinsurgency-dominated strategic context combined with a permissive air environment. Significant technical and conceptual limitations endured throughout the period. The limited and context-specific extent of this UAV 'revolution' should warn against the premature replacement of manned capabilities in Western force structures and doctrine.

This article is adapted from an MA Dissertation, supervised by Professor Philip Sabin and originally submitted to the War Studies Department of King's College London in July 2011.

Introduction

'We have already made a 100-year war-fighting leap-ahead

> with MQ-1 Predator, MQ-9 Reaper, and Global Hawk . . .[they] have fundamentally changed the nature of warfare.'
>
> General (Ret'd) Barry McCaffrey, United States Army, October 2007.[2]

> '. . . remotely piloted planes won't be as effective in future wars as they are in Iraq and Afghanistan.'
>
> General Roger Brady, Commander USAFE, July 2010.[3]

The contradictory comments by Generals McCaffrey and Brady above illustrate the active contemporary debate that surrounds the integration of UAVs into Western military air power. In the main, this discussion has assumed a predictive timeframe of roughly twenty years hence. The authors of the UK's 2009 *Future Air and Space Operational Concept* claimed that, by 2030, 'unmanned platforms will predominate in hostile environments with a requirement for persistence in contested air space, or in homeland resilience tasks'.[4] Western governments have implemented policies that suggest a belief in the imminence and viability of this near-term process of replacement. In 2009, US Secretary of Defense Robert Gates recommended a $2 billion increase in intelligence, surveillance and reconnaissance (ISR) funding, the centrepiece of which would be enhanced UAV operational capabilities and development.[5] Also during that year, the USAF trained more unmanned than manned pilots, and the US Air National Guard 174th Fighter Wing replaced its F-16 aircraft with Reaper.[6] The UK Strategic Defence and Security Review of 2010 announced the removal of Harrier and some Tornado aircraft from service, radically reducing the size of the UK's manned combat air forces.[7] Shortly afterwards, the British Defence Secretary announced plans to double the UK's Reaper force at an increased cost of £135 million, an increase achieved by the purchase of an additional five airframes with which to equip the reformed No 13 Sqn at RAF Waddington.[8.& 9]

The extent to which such decisions have been founded upon a sound understanding of contemporary operational experiences is not clear. A mid-decade US Government report criticised the Department of Defense for not having 'implemented a systematic approach to evaluating joint [UAV] performance on operational deployments', thereby hampering an understanding of ongoing trends and enduring

problems, and perhaps taking industrial proponents of game-changing technological developments too closely at their word.[10] Nevertheless, it seems that advocates of change dominate official attitudes and continue to influence the decisions that will mould future Western air force structures. Beyond political and military discourse, academic observers have also taken differing viewpoints. For example, P W Singer's declarations of 'robotic' revolution are offset by the more measured assessments of Dr David Jordan and Ben Wilkins, who acknowledge the increased relevance of UAVs in the early 21st Century, but who also emphasise the continuing limitations of the technology and its employment. [11]

This article seeks to place an assessment of the military employment and utility of UAVs within the correct operational and air power perspectives, presenting a view that is similar to the Jordan/Wilkins position described above while extending the argument to strongly emphasise the contextual, along with the inherent, limitations that affect contemporary unmanned air operations. Military UAVs did *not* show themselves to be genuine competitors to conventional manned aircraft between 2001 and 2010. Success in mission areas where UAV utility was most evident was enabled by a counterinsurgency-dominated strategic context combined with a permissive air environment. Significant technical and conceptual limitations endured throughout the period. The limited and context-specific extent of this UAV 'revolution' should warn against the premature replacement of manned capabilities in Western force structures and doctrine.

Scope

This article opens with a brief consideration of the relationship between the prevailing counterinsurgency-dominated strategic context and contemporary UAV employment between 2001 and 2010. The article then explores in detail the weaknesses and limitations that were evident in unmanned operations of the period. Here, previously published comparative accident rates are reassessed with the benefit of updated statistics that span the entire decade. Some of the underlying technical issues are then discussed, and Global Hawk provides a short, sharp case study that questions the technical viability of existing programmes of replacement. Issues associated with the paradoxical

manned nature of unmanned warfare are considered. Finally, this article outlines the breadth of additional problems that endured throughout the period, before presenting a concluding summary.

Definitions and Exclusions

This article primarily restricts its focus to military operations in Iraq and Afghanistan during the period 2001 to 2010. UAVs have a much longer history than this; however, details of unmanned operations in earlier conflicts are only referenced when necessary to establish a suitable context. The 2011 conflict in Libya is also referenced only by exception; although it transformed the strategic context for a short time, and has rekindled a planning focus on contingency operations with a light 'boots on the ground' footprint, the Western commitment in Afghanistan continues to dominate US and UK military activity and will likely do so until declared withdrawals are complete in the middle of this decade.

The term 'UAV' is used throughout this article in preference to 'UAS', 'UCAV', 'RPA' and other associated terms, in part due to the established place of this earlier term in existing literature, especially in the US and its armed forces, and partly as a simple stylistic choice and a useful simplification of inconsistent terminology.

This article considers only contemporary USAF-defined 'medium' and 'large' UAVs in Western air force employment: the MQ-1 Predator, MQ-9 Reaper and RQ-4 Global Hawk.[12] These fixed-wing platforms are the most established unmanned types with some degree of equivalency to traditional manned counterparts, and are therefore most suited to an exploration of the viability of near-term replacement. The contribution of rotary-wing platforms such as the MQ-8 to more recent operations is not explored.[13] Small 'throwbots' or primarily army-fielded surveillance UAVs are also outside the scope of the discussion.[14] Novel types such as the Lockheed Martin RQ-170 Sentinel are excluded from this study due to the extremely limited availability of information and their uncertain involvement in pre-2010 operations.[15] The 2011 loss of an RQ-170 in an incident claimed as sabotage by Iran, who presented a supposedly captured aircraft to the world's media, is referenced but not explored in detail due to the limited availability of unclassified data concerning that incident. Parallel CIA activity in Afghanistan and Pakistan is not considered;

An MQ-1 Predator.

this article focuses instead on the employment of UAVs by conventional military air forces. An exploration of CIA-run 'drone' operations in Pakistan can be found in Colonel Andrew Roe's article in the Summer 2012 edition of *Air Power Review*.[16] Flight Lieutenant Kenny Fuchter also focused on extra-military counter-terrorist operations in an article in the Autumn/Winter 2012 edition of the same periodical.[17]

This article is perhaps inevitably dominated by discussions of American experience, a result of the availability of statistics, relative scales of military effort and the status of the US as technological leaders in the field of UAV development. The UK's involvement during this period, as an operator of Predator and Reaper aircraft, is difficult to measure statistically due to a lack of available unclassified data. The Italian experience with Predator in Iraq is acknowledged and discussed briefly, with specific reference to problems of command and control. The experiences of other states that may be assumed to fall within the political West, notably Israel, are excluded.

UAVs and Counterinsurgency: A Good Fit

> '. . . the Iraq War […] was actually the war that proved robots could be useful, which finally led them to be truly accepted . . . This was the war where people said 'UAVs? Yes, give me more!"[18]

The post-9/11 Western military campaigns in Iraq and Afghanistan were fundamentally compatible with the limited capabilities of early 21st Century UAVs. The growth of unmanned participation in intelligence, surveillance and acquisition (ISA) and, to a lesser extent, attack missions was the result of context-specific mission requirements and in-theatre environmental realities. Specifically, the growing dominance of counterinsurgency tasks during extended conflict 'amongst the people', conducted within largely permissive airspace, suited the nascent capabilities of early 21st Century UAVs and also minimised the detrimental effects of defensive limitations.[19]

The primary and most attractive capability behind the increased desire among commanders for UAV employment was the novel 'persistent stare' capability enabled by long endurance. This capability '[*mitigated*] the negative air power characteristic of impermanence', and provided instead a form of 'virtual permanence' that gave the US and its allies 'the ability to deny the enemy a sanctuary both day and night'.[20] 'Persistent stare' co-existed alongside another new ability, the transmission of virtually real-time imagery directly into command headquarters and operations centres. This changed expectations among commanders, who 'no longer [*wanted*] pictures taken last week; they [*wanted*] streaming video with enough clarity and fidelity to anticipate the actions of the enemy'. [21] In effect, UAV video feeds offered a perceived solution to the enduring problem of the 'fog of war'.[22]

These novel capabilities proved to be a particularly 'good fit' within an operational environment that emphasised ISA and precision attack missions. It was in these areas that unmanned platforms demonstrated their most significant absolute and relative growth. This generation of UAVs operated in an environment that was *not* dominated by high-end warfighting, which was truly evident only during the removal of Saddam Hussein's regime in Iraq in early 2003. There were no requirements beyond April 2003 to confront and destroy the military apparatus of an enemy state. Rather, 'low intensity conflict' tasks were required in support of ground forces, including 'providing overwatch [*and*] giving advanced warning of ambushes or obstacles along the route of a convoy'.[23] Close air support to troops in contact, frequently in populated areas, became a dominant feature of each campaign. Potential enemies and known

high-value targets had to be carefully monitored and then if necessary precisely targeted. The precision of these strikes was important in the context of an increasingly casualty-intolerant counterinsurgency doctrine and international opinion.[24] The value contributed by 'persistent stare' and evolving targeting and precision strike capabilities was recognised in a mid-decade *Jane's Defence* study:

> 'It is in 'Long War' related contingencies that [*UAVs*] have already most obviously demonstrated their value on the battlefield. [*UAVs*] have been immensely effective in providing tactical intelligence of terrorist and insurgent locations and movements and […] have also performed strike missions against individuals and small groups.'[25]

This beneficial compatibility between task and capability relied upon a key environmental enabling factor, and that was the permissive airspace environment that existed in both campaigns. Contemporary UAVs lack the means with which to avoid or defend against surface or air-to-air threats, due primarily to compromises in powerplant and payload that enable the long endurance so critical to 'persistent stare' and 'virtual permanence'.[26] General Philip Breedlove, the Vice Chief of Staff of the USAF, summarised this limitation in 2011:

> 'One has to remember that the current ISR fleet […] is absolutely a permissive fleet […] The Predator, the Reaper, the Global Hawk will not fly in contested [*airspace*] and will certainly not fly in denied airspace.'[27]

This defensive inability was not critical in either Afghanistan or Iraq. While unguided and infra-red surface-to-air threats remained as fielded threats in each theatre, the most potent radar-guided and counter-air threats that might have prejudiced the effective employment of this generation of UAVs were absent during the extended COIN phases of each campaign. As a result, the defensive weaknesses of early 21st Century UAVs did not inhibit the synergy between unmanned capabilities and dominant counterinsurgency mission requirements. However, these permissive air environments were atypical and 'unusual in historical terms'.[28] The UK's *Future Character of Conflict* outlines an expectation that future battlespace, including the air environment, will be contested.[29] The utility of

An RAF MQ-9 Reaper of No 39 Sqn.

current generation UAVs in such an environment is likely to be compromised, as demonstrated by the US military's refusal to deploy Global Hawk into the Libyan theatre in early 2011 until integrated air defence systems, such as the long range SA-5, had been sufficiently degraded.[30]

The above-identified 'good fit' was not exclusive. Afghanistan's complex terrain represents a challenge to the operation of even established aerospace technologies.[31] In addition, UAVs offered some contribution to missions beyond those most obviously associated with counterinsurgency operations. For example, a small number of Predators were briefly employed in the SEAD role in 2003 as decoys launched to tempt Iraqi air defence operators into engagements that would reveal the positions of their systems.[32] However, such missions represented only a minor and short-lived facet of the air power effort across the decade as a whole, and overall the 'good fit' was clearly the dominant feature of the interaction between UAVs and operating environment. Any lessons inferred from a decade of unmanned air operations should therefore be understood as being of specific and quite narrow contextual provenance. Such lessons should be applied to processes of doctrinal and structural revision with an explicit awareness of this background, and without inappropriately broad assumptions of onward relevance.

Enduring Limitations

> '[*Global Hawk*] is not operationally effective for conducting near-continuous, persistent ISR as specified in the Air Force Concept of Employment.'[33]

> 'It is not the technology of the UCAV which presents the

challenge, but its intellectual mastery.'[34]

As outlined in the first section of this article, some UAV limitations were mitigated by the essentially favourable operational circumstances in Afghanistan and Iraq between 2001 and 2010. However, many key weaknesses and problems endured despite a permissive air environment and ISA-heavy operational requirements. Many of these have been explored in earlier studies, but it is useful to revisit some of this existing discussion with the benefit of drawing upon a full decade's worth of increasing UAV employment and operational experience. This article focuses on two main areas that question the near-term viability of UAVs as replacements for manned aircraft. The first of these explores the way in which implementation of novel technology remained a very significant challenge throughout the period. UAV accident rates fluctuated but remained high, with evident contributory problems of technological immaturity and poor reliability. A brief case study of Global Hawk offers a useful insight into the extent to which enduring technical issues question the true replacement potential of this generation of UAVs. The second area that is explored, echoing Professor Mason's statement above, is the paradoxically *manned* nature of UAV employment throughout the decade. UAV operations remained a very human affair in Afghanistan and Iraq, with ongoing uncertainties regarding command and control and the place of remote warriors in contemporary military ethos. Beyond these two specific themes, the sheer breadth and variety of the enduring limitations observed between 2001 and 2010 perhaps most undermines confidence in the viable near-term replacement of manned aircraft with unmanned equivalents.

Accident Rates

An early and enduring criticism of contemporary UAVs has been their high accident rates compared to manned aircraft. However, much of the established debate revolves around immature statistical data sets that show high loss rates among medium and large UAVs as they entered operational service. It is important to acknowledge the rapid pace with which UAV platforms and their operating procedures have developed, and now re-examine issues of accident rates and reliability with reference to more recent data.

The authors of the 2005 US Department of Defense *UAS Roadmap*

An RQ-4 Global Hawk.

2005-2030 compared the accident rates of early UAVs with the manned F-16 and U-2.[35] They concluded that, as of 2004, 'the mishap rates of the recent, larger [*UAVs*] track closely with that of the F-16 fleet at a comparable point in its career'.[36] The more recent USAF *UAS Flight Plan 2009 to 2047* also compared Predator and F-16 accident data, agreeing that UAV mishap rates were reducing but stressing that they remained absolutely higher than their manned equivalents.[37] *The Flight Plan* also referenced earlier reports that UAV reliability was a 'critical' factor, and stated that, as of the middle of the decade, inadequate resources had been expended in resolving 'root' reliability issues.[38] This analysis can now be extended by incorporating a greater number of manned and unmanned types and by expanding the period of analysis to the end of 2010. The results of such expanded analysis support the findings and emphasis of the *UAS Flight Plan* over those of the earlier *Road Map*. While year-on-year reduction trends in UAV accident rates remain comparable to those of a selection of manned jet aircraft at similar stages of their service history, the *absolute* accident rates that these trends represent remained intrinsically higher throughout the decade to 2010.

The expanded data adds the Reaper, Global Hawk, A-10 and F-22 to the sample of types that are compared, in addition to the earlier

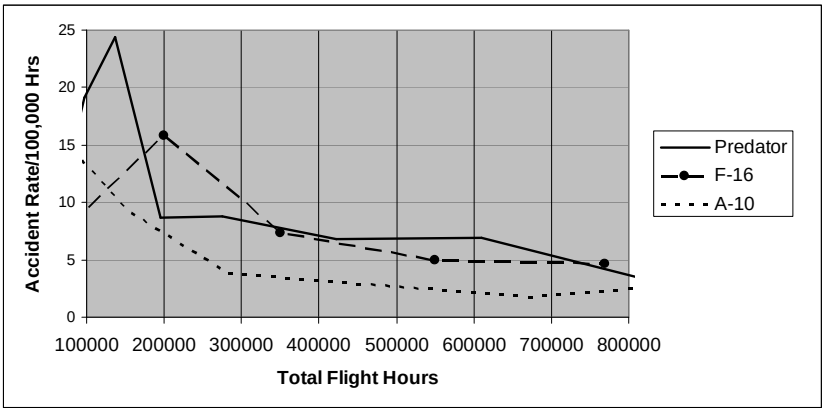


Figure 1: Annual Accident Rate Trends 100,000 to 800,000 Hours: Predator, F-16 and A-10. Source: USAF Air Force Safety Centre

F-16, Predator and U-2 (the latter is considered here only briefly; relevant USAF records for this aircraft did not start until 1970, well into the U-2's service history and so making meaningful equivalent comparison impossible). This data concentrates on the most meaningful measure of comparative accident rates, based upon annual accident rates plotted against accumulated flight hours, thereby continuing the methodology of the earlier *Road Map* and *Flight Plan* studies. Statistics are taken from official USAF accident data and refer to 'Class A' accidents, defined as those that cause 'a fatality or total permanent disability, loss of an aircraft, or property damage of $2 million or more'.[39] The data used in this section does not relate specifically to operations in Afghanistan and Iraq; clearly, the first ten years of service for many of these aircraft types predated 2001. While many of the UAV accidents in this period occurred during deployed operations, it is important to note that this data *excludes* combat losses.[40]

Comparative analysis up to the first 100,000 flight hour mark has already been published for Predator and F-16 in the *UAS Roadmap 2005-2030*.[41] The first set of data presented here extends this earlier study, modified to include the A-10 as a second manned type (which has proved much less accident-prone than the F-16, which has suffered by far the highest accident rate of any manned fighter/attack aircraft that remains within the active US inventory) and now

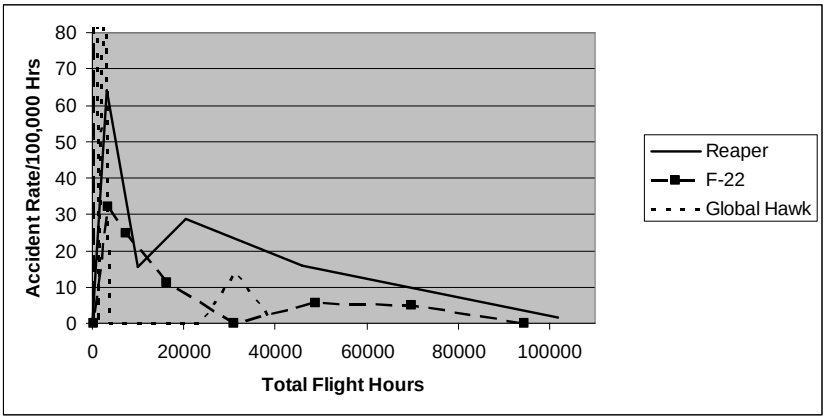


Figure 2: Annual Accident Rate Trends Over The First 100,000 Hours: Reaper, F-22 and Global Hawk. Source: USAF Air Force Safety Centre

incorporating statistics up to the end of 2010. By that date, the Predator had accumulated approximately 800,000 flight hours. A comparison of each of these aircraft between 100,000 hours and 800,000 hours service therefore gives a clear idea of annual accident rate trends as each aircraft type became increasingly established in service. The results are depicted in Figure 1.

This extension of scope essentially supports the findings of the earlier studies. The Predator accident rate continued to show a broadly similar reducing trend to each of the manned types. In fact, the reduction is of greater overall magnitude, having started from a position far higher than either of the manned types. This is noteworthy, as it suggests that UAV accident rates may indeed become comparable to those of manned aircraft as they mature in service. However, it would be easy to overstate the significance of this observation. The graph shows that *absolute* Predator accident rates remained higher than those of F-16 for most of the period overall, and they were significantly higher than the A-10 throughout. Again, the averaged accident rate taken across the entire period supports this, with Predator returning a mean rate of 7·4 accidents per 100,000 hours compared with 6·9 for F-16 and a much lower 3·6 for the A-10. The mean rates for the entire first 800,000 hour period (including the

initial 100,000 hours analysed by the earlier *Road Map* study) were 9·3 for Predator, 8·1 for F-16 and 4·4 for the A-10

It is also possible to now run a similar comparison involving more modern manned and unmanned aircraft types. An initial comparison between Reaper and F-22 is straightforward. The data shows that each aircraft had accumulated approximately 100,000 flight hours by 2010. The speed at which accident rates reduced is depicted graphically in Figure 2, with Global Hawk's lifetime total to the end of 2010 (approximately 40,000 flight hours) added for further comparison.

The erratic 'spikes' on the far left hand side of the graph in Figure 2 show the effect of even a very small number of accidents on the apparent trends of aircraft with very low annual flight hour totals. Early criticism of high UAV accident rates may have been influenced by such 'spikes'. The longer term data is more representative of how accident rate trends settled as aircraft became established, and again these results, here for cutting edge platforms, effectively corroborate the findings of the *Road Map* and *Flight Plan* studies that compared the Predator, F-16 and U-2 over the same equivalent period of their service history. The Reaper exhibited a broadly comparable trend of accident rate reduction to that of F-22 over its first 100,000 flight hours. However, and as with Predator versus F-16 and A-10, Reaper tracked along a line that represented consistently higher *absolute* accident rates, reflected in total accident numbers of 11 during the first 100,000 flight hours compared to 6 for F-22. Thus Reaper remained significantly more likely to suffer Class A accidents than F-22, even as the average accident rates of both types reduced.

Reliability and Design: The *Why* Behind High Accident Rates

Accidents, of course, have causes. Summary causes of mishaps can be found in the results of official UAV accident investigations during the period, of which the USAF published fifty-two between 2001 and mid-2011.[42] Of these, at least thirty-four occurred in Afghanistan and Iraq. In thirty-three of the accidents malfunction or physical failure was identified as the primary cause of the accident. In seventeen cases human error was to blame. On two occasions the cause was attributed clearly to maintenance error.

To first consider the most prevalent group of causes, the thirty-three cases of malfunction and component failure revealed some of the

design and operating limitations of this generation of UAVs. These included significant problems with engines and flight control systems and these persisted throughout the period. A September 2010 report into the crash of a Predator that suffered engine failure in Afghanistan noted that a decrease in vital engine oil levels 'frequently occurs in [*Predators*] due to the design of the oil system'.[43] Moreover, unmanned aircraft were susceptible to physical malfunctions caused by environmental conditions, with several crashes attributed to icing or flight in cloud. Susceptibility to such environmental influences did not have to result in aircraft loss to compromise mission effectiveness. Areas of poor weather that might have been penetrated by manned aircraft would limit the possible operating areas of a UAV, or even necessitate it to abort its mission, during operations in Afghanistan and Iraq.[44] Some of these issues were addressed by manufacturers and operators as the decade progressed. For example, modified systems added to later variants of Predator included 'weeping wing' chemical anti-icing technology, although in a further indication of limitation-driven compromise, this was often removed on operations to allow the carriage of more fuel or weapons.[45] Overall, however, general and airframe-specific problems of design and reliability continued to be evident in accident reports right up until 2010.

Human error, identified in seventeen of the accident reports as the primary cause, was frequently evident as basic errors in handling skills or airmanship that might as easily have occurred among crews of manned aircraft. However, a significant number of accidents was caused or exacerbated by design issues with the ergonomically-poor ground control stations from which the crews remotely operated the unmanned aircraft. One mid-decade accident occurred when a Predator pilot inadvertently shut down the engine instead of raising the gear, a result of a control system where the switches for both functions were virtually collocated and easily confused.[46] Still other accidents were attributed to poor situational awareness caused by a limited sensor field of view and a lack of perceptual cues when 'flying', including losses incurred when attempting to land. These problems were acknowledged by the USAF to represent 'an inherent design flaw'.[47] Such issues present a significant challenge to future UAV operations, as the restoration or replication of such visual and tactile cues will require more advanced solutions than the relatively

easy modification of switch positions within a ground-based 'cockpit'.[48] The evidence of unmanned operational performance over the past decade in these areas of design and reliability demonstrates the size of the task facing UAV developers if they are to meet some of the bolder forecasts regarding the extent to which their creations might replace traditional manned aircraft.

At the Technological Edge: Datalink Reliability and Security

The phrase 'lost link' is commonly encountered within accident report summaries and Predator operator testimony. Failure of these datalink systems, loss of signal and a subsequent inability to control the aircraft, was the primary cause of at least three of the investigated accidents, and was a contributory factor in several more. For example, the investigation into a Predator crash in Afghanistan in December 2003 while supporting Operation ENDURING FREEDOM found that the datalink could not function at extreme aircraft attitudes, encountered in this instance during an attempted recovery from a stall.[49] Another Predator crashed in Afghanistan in January 2005 following a system freeze at its remote ground control station, and the subsequent loss of all satellite communications with the aircraft. Despite flying the 'lost link' profile for more than 12 hours, control could not be restored and the UAV was lost.[50] A failed datalink also brought about the demise of a Reaper that had to be shot down over Afghanistan in 2009 by a USAF F-15. Even a simple power surge at a ground control station would invariably mean a temporary loss of control of the associated UAVs. [51] Such fragility undermines forecasts that UAVs might undertake dynamic missions such as offensive counter-air and air defence, even in the mid-term.

It was not only the serviceability of UAV datalinks that appeared uncertain between 2001 and 2010. The possibility that UAV links may be jammed or severed, or that critical operating systems and networks may be compromised, was and remains a continuing concern.[52] AVM Professor Tony Mason pointed out in a recent RAF study that: 'any system which depends on electronic control is vulnerable to electronic disruption'.[53] General concerns of cyberattack seem increasingly well founded. In 2010 the Stuxnet virus attacked specific technologies that were largely associated with the Iranian nuclear programme.[54] Threats of this nature were referenced by US Deputy Secretary of Defense

The little-publicised RQ-170 Sentinel.

William Lynn in a cautionary 2010 debate on cyber warfare.[55]

Specific questions of UAV datalink security, and of the information that is transmitted by them, were raised in response to one particular, and spectacular, occurrence in 2009. A US raid on Shiite militia in Iraq found evidence that the insurgents had been hacking into the real-time video feeds transmitted by Predator aircraft.[56] This imagery was transmitted via unencrypted signals, and the insurgents were able to tap into the video using simple, cheap commercial software. The US military subsequently admitted that this had been a known weakness since the 1990s, but it had been 'assumed [*that*] local adversaries wouldn't know how to exploit it'.[57]

Finally, although this article deliberately avoids detailed discussion of the supposed Iranian downing of an RQ-170 in 2011 due to the ambiguous unclassified information that concerns that event, the very possibility that the aircraft was lost as a result of either failure or adversary 'hacking' does little to inspire confidence in how robust these systems have become. These persistent uncertainties, associated with the reliability and security of the control technologies that are vital to UAV operations, question the assumption that near-term unmanned platforms might undertake missions truly critical to national defence. Significant advances will be required from the aerospace industry in this area, and it should be noted that the same industry has struggled to deliver the next generation of *manned* combat aircraft, the F-35, on time, under budget, and with all promised capabilities.[58]

Global Hawk and U-2: A Short Case Study in Replacement

> 'Technology must deliver, not merely promise to deliver, the same level of competence in [UAVs} that we have learned to [*expect*] in manned aircraft.'[59]

This question of the ability of the aerospace industry to deliver on capability promises can be explored with a brief consideration of Global Hawk as a specific and recent case study. Global Hawk has long been viewed as a replacement for, rather than merely a complement to, the U-2, and it was active in both Afghanistan and Iraq during the decade 2001 to 2010.[60] As of 2006, the capabilities of the two types were still not analogous, with the Global Hawk's strengths in range and endurance being offset by the U-2's better sensor suite and payload/power advantage.[61] The early Block 10 Global Hawk was subsequently criticised for low reliability rates in 2007, questioning the ability of the manufacturer, Northrop Grumman, to resolve myriad persistent technical issues.[62] As a result, by 2009 the Air Force had accepted a revised, delayed timeline for the planned process of replacement of the U-2, based on the need for further development to ensure that Global Hawk would more satisfactorily replace the U-2's capabilities.[63] The next 'Operational Test and Evaluation Report', carried out for the successor model of Global Hawk, the Block 30, was conducted between October and December 2010. It concluded that 'the RQ-4B Global Hawk Block 30 is not operationally suitable.'[64]

The report cited 'frequent failures of mission-critical air vehicle components' as key factors that 'reduce take off reliability and increase mission abort rates.'[65] These failures were further exacerbated by shortages of critical spare parts, another criticism of the manufacturer's ability to deliver on promised capability. Global Hawk was also identified as being incompetent as a signals intelligence platform due to 'technical performance deficiencies and immature training, tactics, techniques, and procedures.'[66] In all, the Global Hawk could 'produce only 42 percent of the tasked ISR coverage time due to poor take off reliability, maintenance ground aborts, and high air abort rates.'[67] The somewhat meek USAF response to this report could only claim that Global Hawk aircraft had performed 'quite well' since August 2009.[68] This brief example

Contrary to expectations, Global Hawk's capabilities were not sufficient to make it a satisfactory replacement for the U-2.

clearly questions the suitability of even recently updated UAVs as replacements for manned aircraft, even when considering an example of a clear and intended programme of specific type-with-type replacement.

The Manned Aspects of Unmanned Air Warfare

> 'It bears noting that Predator and Global Hawk are not unpiloted; their pilots are simply not aboard the aircraft.'[69]

The reference in the Global Hawk evaluation report to 'immature training, tactics, techniques, and procedures' reveals another important consideration that was highlighted by the experience of unmanned air operations between 2001 and 2010. The technological aura surrounding UAVs threatens to obscure the enduring *human* role in supposedly unmanned warfare. This is not in itself an especially novel observation. Nor is it linked only to UAVs, for an excessive focus on technology has long been an accusation aimed at Western warfare in general.[70] However, this is an important theme, and it has enormous relevance for ideas of the unmanned 'replacement' of traditional air power. This article does not discuss hypothetical scenarios comparing 'man in the loop' systems with developments in autonomy.[71] A

consideration of the ethical issues surrounding such developments can be found in Wing Commander Nick Tucker-Lowe's article in the Autumn/Winter 2012 edition of *Air Power Review*[72] (reproduced in *RAF Historical Society Journal* 58, pp41-60). Rather, the focus will remain upon trends that could be observed in operations in Afghanistan and Iraq between 2001 and 2010, and two trends in particular were evidently problematic during that period. The first of these was the troubled integration of UAV capabilities into existing concepts and procedures of command and control. The second was the uncertain place of remote combatants within contemporary military organisations and ethos. In each case, the employment of UAVs either failed to overcome essential and enduring problems, or raised new issues that military organisations and their personnel were required to face.

To first address issues of command and control, the 'persistent stare' and associated real-time imagery that contemporary UAVs provided created a tendency towards a 'long screwdriver' interference by commanders as far back as Operation ALLIED FORCE in 1999, and that tendency would become more apparent as UAV use increased after 2001.[73] P W Singer has labelled this phenomenon the 'Tactical General', in an apparent nod to the contrasting idea of the 'Strategic Corporal' previously suggested by Marine Corps General Charles Krulak.[74] Singer offers several illuminating anecdotes in support of this concept. During the initial stages of Operation IRAQI FREEDOM, General Tommy Franks was reported to frequently command UAV operators directly, effectively removing every mid- and low-level commander positioned in the chain between himself and the UAV crews, in contradiction to extant doctrine that promoted principles of delegated mission command.[75] One soldier described how his patrol in Afghanistan was interrupted so that a distant commander could discipline soldiers for untucking their shirts and removing their headwear, uniform violations that had been observed via a Predator video feed.[76] More significantly, the distant involvement of too many officers could lead to operational paralysis and conflicting tasking orders, demonstrating how the 'persistent stare' capability that was so beloved of contemporary commanders could in fact represent a drawback rather than a key advantage.[77]

Such command and control issues, in particular the paralysing

impact of contradictory tasking imperatives, were also evident in the experiences of the small Italian Predator force that operated in Iraq from 2005. Problems included poor communications between the commanders of the air component and the overall joint task force, and competing pressures to fulfil both strategic and tactical tasking.[78] On occasion, direct approval from the Defence Chief of Staff in Rome was required to approve the transfer of Predator assets from tactical national missions to international strategic tasks.[79] Moreover, a lack of familiarity with the limitations of contemporary UAVs, notably in terms of the air power characteristics of speed and reach, led to inappropriate and wasted efforts to 'scramble' Predator aircraft in support of ground forces.[80] These experiences were in many ways an exaggeration of American problems, exacerbated by the complete novelty of UAV operations for Italian forces. Nonetheless, they further demonstrated the difficulties of integrating remote unmanned technologies, with real-time command visibility of tactical output, into the operating concepts and organisations of established air forces. These significant difficulties were prevalent even within a favourable context, in which UAVs participated in only a narrow range of missions, much less across the broad spectrum of military air power activities.

It was not only air power structures that struggled to incorporate novel and remotely operated unmanned aircraft. The integration into the existing 'manned' ethos of unmanned warfare, and the novelty of pilots and crews who continued to fight and kill while exposed to virtually no risk to themselves, proved to be contentious and ambiguous as UAV operations expanded. Removing the human 'weak link' may resolve problems such as air power's relative impermanence, but it is the man, and not the machine, that remains the vital element when considering the less tangible aspects of warfighting. This, again, is not an especially novel observation. Air Commodore Neville Parton asked in the introduction to a 2009 Royal Air Force study: 'Will the UAV operators be perceived as heroic by the troops they support on the ground, or dissociated technicians with no real understanding of the nature of warfare?'[81] However, one specific example serves this article's argument by casting still further doubt on the imminent readiness of Western air forces, and militaries in general, to undergo a significant process of 'replacement' by which

the man is first made truly remote, and is then potentially removed altogether, from air warfare.

Brigadier James Bashall commanded 1 Mechanised Brigade during the withdrawal of British troops from Basra city in 2007. While recounting his experiences at a Royal Air Force-sponsored conference in September 2010, he emphasised the critical importance of face-to-face involvement with British fast jet aircrew for both mutual operational understanding and unit morale, in effect allowing his men to put faces to what would otherwise be remote voices offering air support via radio.[82] In this, Brigadier Bashall suggested the intrinsic human nature of conflict, and the importance of bridging the traditional divide between those who operate on the ground and those who operate in the air, frequently from a distant location. Brigadier Bashall's anecdote hinted at an important interpersonal aspect of air-land cooperation, and one that was difficult to conduct even within the manned-aircraft dominated conflict in Iraq. Such interaction will surely be even more difficult in an era in which air power might be delivered primarily by remotely involved crews who remain in distant homeland locations.

While this anecdote represents only a single example from the campaigns fought in Afghanistan and Iraq over the past decade, it demonstrates the continuing reliance of military forces upon camaraderie and reciprocal confidence that is enhanced by simple human proximity and personal interaction.[83] The consequences of removing these, upon operational understanding and raw fighting spirit, are unknown. Such enduringly human issues as those discussed above do not necessarily preclude a 'rise of the robots' that replaces manned aircraft with unmanned equivalents. They do, however, demand that any such process be based on well-founded understanding that is based on experience, rather than a superficial appreciation of complex issues that is based on hypothetical forecasts, or hope.

Niche Capabilities, Full-Spectrum Problems

Each of the technical and conceptual themes explored above represented a significant issue for UAV operations in Afghanistan and Iraq between 2001 and 2010. However, it is potentially the *breadth* of these issues, each apparent even within a context that was essentially

favourable for UAV operations, that ought to give the greatest pause for thought. A rapid summary of some of the most significant additional limitations and areas of ambiguity that have not been discussed above gives an appreciation of their sheer quantity. Cost, long assumed to be a favourable aspect of removing men and support systems from aircraft, became an increasing issue as the decade progressed. The 2005 *UAS Roadmap* found that the per-pound payload costs of contemporary UAVs were higher than those anticipated for F-35, and by 2008 a sensor-laden Reaper was estimated to cost $18 million.[84] Increased data collection enabled by unmanned air operations created problems with both bandwidth and subsequent information exploitation.[85] In Afghanistan and its sister-theatre of border Pakistan, UAV activity was reliant on intelligence 'cueing' derived from very human sources, and indeed at considerable human cost, as apparent in a revenge attack by a Taliban bomber against CIA operatives in Afghanistan in December 2009.[86]

Some studies have suggested that the increased distance from which war may now be waged increases the ease with which decisions to apply deadly force may be reached.[87] The negative implications of inflicting civilian casualties during the conduct of counterinsurgency operations have been made explicit within the guidance issued to Western forces in recent years, and example from Uruzgan Province in Afghanistan in 2009 revealed a serious number of failures in the judgement of unmanned operators.[88] While such failures are an ever-present risk for any participant in warfare, the official report of this incident highlighted specific failures in Predator operating and training procedures.[89] This article has not considered potential legal issues with the application of the Laws of Armed Conflict to remotely involved personnel of ambiguous combatant status, but the surrounding debate is detailed and many issues remain unresolved.[90]

Several reports have highlighted issues of fatigue and stress among UAV crews that were rooted in unrelenting operational tempo, disassociation from theatres of operations, and the mental challenges of remaining collocated with family while fighting a war of remotely inflicted violence.[91] Issues of training, tour length and career progression led to problems with morale, with the commander of the USAF Predator wing, in this case a former F-16 pilot, likening the completion of a UAV tour of duty to being 'a prisoner with a life

A tour of duty at an MQ-1 Predator control station has been compared to being 'a prisoner with a life sentence'.

sentence'.[92] The 2009 *UAS Flight Plan* recommended as a result that the USAF must 'assess and adjust [*UAV*] pilot development paths, to include incentive pay and career incentive pay issues' in order to guarantee future force efficiency and retain experienced personnel.[93] The *Flight Plan* further lamented personnel management problems that had been created by 'decisions that frequently are fragmented, reflect legacy culture, and limit innovation'.[94]

Finally, domestic training activity remained, and remains, limited by problems that prevent the integration of UAVs into civilian airspace.[95] The sheer quantity of these limitations, all persistent as the decade progressed, is perhaps the most damning indictment of any proposal that unmanned aircraft stand ready to supplant, rather than supplement, their manned equivalents within Western air forces.

Conclusion: Replacements, or Pretenders to the Throne?

> 'Robots in Iraq and Afghanistan today are sketching out the contours of what bodes to be a historic revolution in warfare… a process that will be of historic importance to the story of humanity itself.'[96]

> ‘The more certain that people are of what the future holds, the more worried and critical a response they should receive.’[97]

Prior to the UK Strategic Defence and Security Review of 2010, British General Sir David Richards suggested that fleets of UAVs operating alongside light attack aircraft would represent reduced but acceptable capabilities with which to replace modern fast jets.[98] These remarks seemed to reflect an expectation of the enduring nature of recent conflict, that counterinsurgency and similarly waged ‘wars amongst the people’ would dominate the coming strategic landscape. However, General Richards did not acknowledge the favourable relationship between capability and context that defined unmanned air operations over the preceding decade, nor the limitations that had clearly been endured. Moreover, many observers have increasingly stated, and indeed experience has shown, that future conflict may *not* resemble the COIN-dominated campaigns in Afghanistan or Iraq.[99] The successful air campaign over Libya in 2011 did not validate the type of capabilities mix that General Richards forecast and recommended.

The stated aim of this article was to contribute to existing debate by establishing a context-aware understanding of early 21st Century UAV operations. This article has shown that the most significant advances, made within the specific missions of ISA and, to a lesser extent, attack, were enabled by a favourable context that matched capabilities to requirements within a permissive environment. Individual problems and limitations endured, including intrinsically higher unmanned accident rates, myriad technical difficulties, industrial inability to deliver on capability promises, and conceptual issues that included the potential loss of critical ‘manned’ aspects of joint warfighting processes and ethos. Ultimately, all of these factors combined to present at best a picture of a one-dimensional and imperfect ‘revolution’ and, at worst, a poorly misunderstood phenomenon that threatens the West’s established advantage in combat air power if it encourages premature and far-reaching force restructuring and doctrinal shifts.

Air power matters. It represents a key aspect of the West’s defence against a variety of potential threats. It is therefore important that the strength of Western air forces should be at least preserved or, better,

enhanced. To unquestioningly accept views that imply too wide a relevance to the counterinsurgency-bounded achievements of UAVs during the past decade would risk contributing to the creation of 'a bespoke counter-insurgency force with niche capabilities [*that*] won't provide policy-makers or political decision takers with a flexible military lever of power for the mid-to-long-term', a warning issued by Air Chief Marshal Sir Steven Dalton in a statement prior to the 2010 Strategic Defence and Security Review.[100] The history of air power is full of sweeping, technology-induced and promise-led change. However, in order that the current debate is concluded with a beneficial outcome, it is crucial that the pace of change should be appropriate, and based upon observed, and not merely promised, development. It is right to innovate and to stretch for capability advantages. But it would be easy to overreach, and to change too much, and too soon, before capabilities are demonstrably worthy of confident adoption. There is a significant disconnect between what industry-promised future platforms *might* do, and what early generation UAVs *can* do, even within an essentially favourable context. As we move further into the second decade of an uncertain 21st Century, it is far from clear that the replacement of the manned aircraft should be close at hand.

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TO THE VICTOR, THE SPOILS: THE RAF'S TOXIC LEGACY FROM THE DISSOLUTION OF THE LUFTWAFFE IN 1945

Wing Commander Trevor Stone

A little known aspect of the RAF's work in Europe at the end of the Second World War was the part it played in the dissolution of the *Luftwaffe*. This was a sizeable task and saw the Service responsible for dismantling the *Luftwaffe*, along with Nazi Germany's anti-aircraft (*Flak*) forces and its military aviation industry. The story was related in an article which appeared in the RAF's magazine, *Air Clues*, in 1986 by Gp Capt G Thorburn of the MOD's Air Historical Branch.[1] His article, based on the British Air Forces of Occupation (BAFO) two-volume account, *Dissolution of the Luftwaffe*, concluded with the point that the task was completed in December 1946, an achievement which enabled the disbandment of the main Disarmament HQ at that time.[2] More recent scholarship, however, shows that there was a *toxic legacy* from the *Luftwaffe's* munitions arsenal which endured beyond 1946.[3] It was a chapter in the story of the disarmament work which was not closed until as late as 1956. This short paper draws on this recent work, adding further detail and placing it in context with the disarmament task at the end of the war.

The war in Europe came to an end at midnight on 8 May 1945. The impact of the conflict, as described by the British historian Robert Parker, was one of casualties, crisis and change.[4] The extent of the casualties was on a scale difficult to comprehend – military and civilian, male and female, old and young. The crisis in Europe is perhaps typified by the fact that, even by 1942, 'tens of millions of men, women and children were displaced from their homes'.[5] In 1945 there were approximately fourteen million uprooted people in Germany and some three to four million Germans who had been made homeless.[6] The extent of change is more difficult to illustrate but perhaps the most significant was geopolitical, following the Potsdam Conference in 1945; this saw Germany divided into four zones, individually controlled by Britain, America, France and the Soviet Union, with each nation also controlling one sector of Berlin.

Even though the fighting in the closing stages of the European war had, for many Germans, been to the bitter end, it had not consumed all

of its military material resources. Although German aviation fuel supplies had become desperately short in the closing days of the war, there were still substantial quantities of aircraft, aero-engines and munitions at its storage depots and operational units. The resources to support the *Luftwaffe* during the war had been substantial. In the years 1939 to 1945, German industry had produced a total of 117, 881 aircraft and 184,075 aero-engines.[7] Fuel stocks peaked at some 574,000 tons at the end of April 1944.[8]

It is amongst Germany's munitions arsenal though, that the *toxic legacy* which this paper explores, began to emerge. As the disarmament work progressed, the RAF found enormous quantities of ex-*Luftwaffe* munitions amounting to 195,841,651 rounds of ammunition, 170,887 tons of High Explosive bombs and 13,770 tons of various pyrotechnics. They also uncovered great quantities of chemical weapons. Although earlier intelligence information suggested that the Germans had no plans for their use, they had amassed thousands of tons of such weapons by the beginning of 1944, including substantial stocks of the chemical agents Tabun and Sarin.[9] Large quantities of Tabun, for example, had been produced at the Anorgana GmbH factory located at Dyhernfurth (now the town of Brzeg Dolny in South West Poland). The US Strategic Bombing Survey estimated that, between 1942 (when the plant became operational) and 1945, some 12,000 to 15,000 tons of Tabun had been produced there.[10]

The way disarmament was to be handled was discussed towards the end of the war, with the four allies agreeing that they would each be responsible for this task within their respective zones of occupation. The British approach was that the Royal Navy, the Army and the RAF would each take care of their equivalent service. It was this agreement which gave the RAF the responsibility for dismantling the *Luftwaffe*, along with anti-aircraft forces and Germany's military aviation industry.[11] As early as August 1944, the Air Ministry had authorised the formation of an Air Disarmament Headquarters, initially within HQ 2nd Tactical Air Force (TAF), then transferring to HQ BAFO Germany in July 1945. The task, codenamed Operation ECLIPSE, fell to three of the four groups within 2nd TAF: No 2 Group was responsible for the Westphalia and Rhine provinces; No 83 Group for Schleswig Holstein and Denmark and No 84 Group for

Hanover Province and Berlin. The Headquarters element directly supervised activity in Belgium, Holland, Denmark and Norway.[12] Within the Groups, the practical task of searching for, identifying, and reporting enemy war material rested with dedicated Air Disarmament (AD) Wings; by July 1945 the full quota of disarmament staffs was in place and fully operational.[13] This organization was complemented by five RAF bomb disposal squadrons who were employed to dispose of all ex-*Luftwaffe* munitions which were discovered by the AD Wings.[14]

The collection and disposal of munitions was one of the more hazardous activities, the risk of which increased as a number had deteriorated in open air storage. Moreover, many of the storage areas had also been booby-trapped. All of this, coupled with the fact that the Germans had attempted to destroy some munitions, left these storage sites in a highly dangerous and chaotic state. It is not surprising that accidents did occur and ten RAF bomb disposal personnel were killed and a further nine were injured during this work.[15] In the early months of the disarmament work much of the munitions disposal was conducted on land although this proved to be difficult in terms of finding suitable areas where the effects of blast and shock waves could be contained. The most practical, and less hazardous, means of disposing of both conventional and chemical weapons was by dumping at sea and permission was granted for this to be accelerated from October 1945. The method employed was for suitable, surplus marine vessels (known as hulks) to be loaded with munitions, towed out to sea and then scuttled in water not less than 300 fathoms deep. Most of this work was carried out from the ports of Emden, Kiel-Nordhaven and Lübeck-Schlutup.[16] The disposal of chemical weapons was a time consuming and particularly hazardous operation and by the time that the main disarmament work had concluded in December 1946, some 43,714 tons of chemical warfare bombs had been disposed of.[17]

The BAFO record of the dissolution of the *Luftwaffe*, however, provides no real detail regarding the types of chemical weapons which were handled during the disarmament. As highlighted earlier in this paper, the Germans had manufactured large quantities of Tabun and Sarin bombs and it was these that attracted quite different attention from other chemical munitions which had been destroyed. At the time of the German surrender, the war in the Far East was still to be won

and it was against this backdrop that it was decided to retain stocks of Tabun and Sarin for possible employment in that theatre. The US government agreed that Britain would take charge of the Tabun filled bombs, of which some 71,000 filled 250 kg bombs were located and needed to be returned to the United Kingdom for storage. This was not a straightforward matter and the question of where to locate them safely was of prime concern in the planning. Eventually, it was decided to locate them on the west coast of Britain where any leakage would probably be carried out to sea by the prevailing winds. The site chosen was Llandwrog airfield, situated south of Caernarvon and established as No 277 Maintenance Unit (MU) in August 1946. All 71,000 Tabun-filled bombs had been moved there from Hamburg in Germany, via Newport docks and No 31 MU at Llanberis (where they were checked for safety), by the middle of July 1947. The dropping of the atomic bombs in August 1945 precluded the need to consider using the Tabun in the Far East and they remained in store at Llandwrog, slowly deteriorating in the salt-laden air from the Irish Sea. There is some suggestion that the bombs' contents might have had some potential as part of the UK's arsenal in the early years of the Cold War.

By the early 1950s, however, the extent of corrosion and general deterioration of the Tabun bombs meant that they ceased to have any military or scientific value which led to the decision in June 1954 that they would need to be disposed of; formal Air Ministry authority for deep sea dumping was eventually granted on 22 March 1955.[18] The disposal operation, codenamed SANDCASTLE, was coordinated by 40 Group Maintenance Command, and was carried out in close cooperation with 42 Group, which had been responsible for the bombs whilst they had been in storage, and the Royal Army Service Corps (RASC).

The operation was conducted in two parts, each of three phases. Phase One was perhaps the most time-consuming and hazardous part of the work as it involved preparing the weapons for movement and reducing the hazard from possible leakage. Each of the bomb access cavities was sealed and the tail units removed to reduce the overall space required during movement and eventual loading onto the vessels which were to be used for the deep sea dumping. Phase Two was the initial movement of the bombs from the MU at Llandwrog to the

nearby beach at Fort Belan where they were loaded on to Landing Craft Tanks (LCT) by Nos 45 and 99 Coys (Water Transport) RASC, eventually moving by sea to Cairnryan for eventual reloading on to the vessels for transport out to the dumping area.[19]

The site at Cairnryan (No 275 MU) had been formed as one of the RAF's Explosives Disposal Units in November 1945, on a site on the east bank of Loch Ryan, approximately five miles north of Stranraer in West Scotland.[20] A military port had been established there during WW II as part of a scheme to provide reserve locations in the event that any of the ports on the east or south coasts of the UK were put out of action through enemy attack. The MU at Cairnryan had been heavily involved in the disposal of explosives since the end of the war, a task which soon led to a sub-site having to be established at the port of Silloth on the Solway Firth in Cumbria, west of Carlisle in late August 1946. The detachment at Silloth was relatively small, consisting of two RAF Equipment Branch officers and approximately thirty airmen of various trades, but working under the overall supervision of No 616 Water Transport Company of the RASC. Much of the loading of the coasters used for the deep sea dumping, however, was carried out by personnel from the Ministry of War Transport or dockers from the Silloth Port Authority, London and North Eastern Railway.[21] By the end of September 1946, 180,221 tons of Army and RAF munitions had been disposed of; by the end of 1949 the RAF had dumped some 137,767 tons.[22] The dumping of the German 250 kg Tabun-filled bombs in 1955/56, by comparison, was a somewhat safer operation than the earlier post-war disposals.

The most hazardous cargo to be handled then had been phosgene gas canisters. The first RAF load to be disposed of was dumped at sea in mid-September 1946 from the coaster RASCV *Sir Evelyn Wood*. In his report to OC 275 MU, the officer in charge recounted how two canisters had unexpectedly floated to the surface when they were thrown overboard. Clearly, these had to be dealt with. When all ships involved had been moved up-wind and personnel had donned gas masks '*rifle fire was opened up on the bombs, from approx. 100 yards*'. It took some effort to damage these bombs sufficiently enough for them to sink and '*the first bomb received ten hits, and then quietly sank; the second required thirty hits before sinking*'.[23] Even before loading on the coasters, handling these bombs could prove highly

problematical. Whilst loading was in progress of the coaster *Malplaquet* on 18 September 1946, one of the civilian workers drew the attention of the officer in charge to the fact that there was a leaking bomb in the hold of the ship. Having donned gas masks, he and two dockers descended into the hold and with the help of the loading crane, extracted the culprit bomb to the quay side. The leaking nose cap was sealed by the liberal application of red lead and then a cloth pad soaked in caustic soda.[24]

Corroding ammunition in a rusting sunken hulk – there may well be another, as yet untold, chapter to the tale of the 'toxic legacy' of WW II.

Once the chemical weapons of Operation SANDCASTLE reached Cairnryan they were unloaded from the LCTs ready for reloading on to the main vessels. The first part of Operation SANDCASTLE took place in the middle of 1955. The first ship purchased for this purpose was the former cargo ship SS *Empire Claire* which had an estimated capacity for some 16,800 weapons. The first LCTs started to move the bombs on 13 June 1955 and the loading of the *Empire Claire*, with the first batch of 16,088 bombs, was completed by 21 July. The ship sailed in the early morning of the 25th along with two RASC vessels as escorts and the tug *Forager* as a standby. In the event, the services of the tug were soon required as the *Empire Claire* broke down on the afternoon of 25 July and was taken under tow, reaching the scuttling site early on the 27th. By 1012 hours that day, the scuttling charges had been detonated and the SS *Empire Claire* and her deadly cargo had disappeared into the murky depths of the Atlantic. The second part of the operation commenced on 4 April 1956, with two ships having been purchased for scuttling: the SS *Vogtland* which sailed on 30 May and the SS *Krotka* which sailed on 15 July. Whilst most of the conventional munitions disposed of by Cairnryan and Silloth were dumped in the area known as Beaufort's Dyke, a deep sea trench in

the Irish Sea, the chemical bombs disposed of under Operation SANDCASTLE were dumped in much deeper waters (2,500m) in the Atlantic Ocean, north-west of Ireland.[25]

Thus, by the end of July 1956, the final load of the *Luftwaffe's toxic legacy* (some 54,609 chemical bombs) which the RAF had stored in the United Kingdom since the end of the Second World War, had met a watery grave. Sea disposal of munitions continued until 1972 when agreements were reached in two International Conventions which controlled the dumping of materials at sea. The use of the world's oceans for the dumping of unwanted materials was finally curbed when the UK signed the convention for the protection of the marine environment of the North East Atlantic, known as the OSPAR[26] Convention, in September 1992.[27]

Notes:

1 Thorburn, Gp Capt G; 'Operation ECLIPSE – The RAF's Part in the Dissolution of the Luftwaffe', *Air Clues*, Vol 40, No 4, pp147-150.

2 British Air Forces of Occupation Germany (BAFO), *Dissolution of the Luftwaffe* , Vols I and II, Feb 1944-Dec 1946, AHQ BAFO dated July 1947.

3 See McCamley, N J; *Secret History of Chemical Warfare* (Barnsley: Pen & Sword, 2006).

4 Parker, R A C; *The Second World War – A Short History* (St Ives: Oxford University Press, 2001), p281.

5 *Ibid*, p295.

6 *Ibid*, p298.

7 Overy, R J; *The Air War 1939-1945* (Dulles: Potomac Books, 2005), p.150. The figures for aircraft production vary throughout the literature but the extent of Professor Richard Overy's scholarship in this field provides a sound basis for including this data as a reliable source. See also: Daniel Uziel, 'Between Industrial Revolution and Slavery. Mass Production in the German Aviation Industry in World War II', *History and Technology: An International Journal*, 22:3, 293 and Parker, *The Second World War*, p133).

8 Air Ministry (ACAS[I]), *The Rise and Fall of the German Air Force* (1933 to 1945), Air Ministry Pamphlet No 248, (1948), p348.

9 Overy, Richard; *The Bombing War – Europe 1939-1945* (London: Allen Lane, 2013), pp380-381.

10 McCamley, *op cit*, p129.

11 Thorburn; 'Operation ECLIPSE', pp147-150.

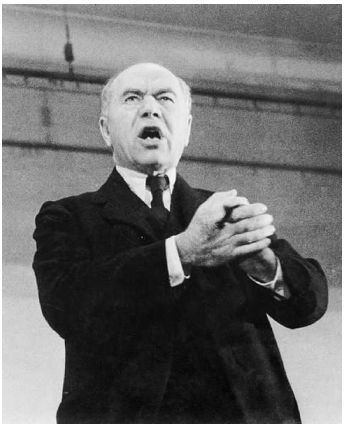
12 *Ibid* and Taylor, Bill; *Royal Air Force Germany Since 1945* (Hinckley: Midland Publishing, 2003), pp226-227.

13 The number of Air Disarmament Wings within each Group varied. Within 2 Group there were six; within 83 Group there were three and within 84 Group there were four. See Taylor, *Royal Air Force Germany Since 1945*, pp226-227.

[14] BAFO, *Dissolution of the Luftwaffe*, Vol I, p29.
[15] *Ibid*, p39.
[16] BAFO, *Dissolution of the Luftwaffe*, Vol II, p123.
[17] BAFO, *Dissolution of the Luftwaffe*, Vol I, p39.
[18] McCamley, *op cit*, pp136-138 and TNA AIR 17/53 – Operation SANDCASTLE (disposal of ex-German CW bombs): Storage dated 1955-1956.
[19] TNA AIR 17/55 – Operation SANDCASTLE (disposal of ex-German CW bombs): Operation Order dated 1956.
[20] Sturtivant, Ray; Hamlin, John & Halley, James J; *Royal Air Force Flying Training and Support Units* (Tunbridge Wells: Air Britain, 1997), p216.
[21] RAF Logistics Heritage Centre (LHC) Archive, HQ 42 Gp, Group Administrative Instruction No 138, Disposal of Explosives and Chemical Weapons from Silloth, Reference 42G/9550/1/0.1 dated 26 August 1946.
[22] Conventional weapon disposal operations continued up to 1956 when the last of the surplus 4,000lb, 8,000lb and 12,000lb bombs had been disposed of; by that stage, at least a further 47,500 tons of munitions had been dumped since 1950. Although the RAF had withdrawn from Cairnryan and Silloth by 1957, the military port (under Army operation) continued until 1960.
[23] RAF LHC Archive, Report by Officer i/c No 275 MU Detachment, Dumping of Phosgene Gas, 275MU/Det/102/Arm dated 16 September 1946. More detailed standard procedures were later put in place to ensure that any phosgene gas 'floaters' were quickly spotted and taken care of.
[24] RAF LHC Archive, Report by Officer i/c No 275 MU Detachment, Leaking Gas Bombs – Silloth, 275MU/Det/102/Arm dated 24 September 1946.
[25] The SS *Empire Claire* and SS *Vogtland* were both scuttled at 56°30′N, 12°00′W and the SS *Krotka* at 56°31′N, 12°05′W. See Beddington, J and Kinloch, A J; *Munitions Dumped at Sea: A Literature Review June 2005* (Imperial College London Consultants).
http://webarchive.nationalarchives.gov.uk/20121203135425/http:/www.mod.uk/DefenceInternet/AboutDefence/CorporatePublications/HealthandSafetyPublications/DSEA/DisposalOfMunitionsAtSea.htm [accessed 3 March 2015]
[26] OSPAR – a contraction of Oslo and Paris where the first conventions to protect the marine environment of the North-East Atlantic had been held in 1972 and 1974 respectively.
[27] Bowles, R; *Beaufort's Dyke Background* (2006), http://www.mod.uk/NR/-rdonlyres/52954E9D-A12E [accessed 29 March 2012].

BEAVERBROOK'S AMERICAN MERLINS

George Galaska



Lord Beaverbrook making a speech during WW II.

On the 14 May 1940, four days after becoming Prime Minister, Winston Churchill appointed his old friend Lord Beaverbrook, controversial proprietor of the *Daily Express* and other mass circulation newspapers, to his cabinet. Beaverbrook was made head of a new department – the Ministry of Aircraft Production (MAP) – which was to take over responsibility for aircraft procurement from the Air Ministry (AM).

In the 1930s, as the threat from Germany grew, Churchill had been a prominent critic of successive governments about what he saw as the inadequate pace of British rearmament, especially in the air, and his criticisms extended to the performance of the AM. His experience as Minister of Munitions in the First World War had persuaded him that separating the AM from its procurement responsibilities was going to be essential. On the 17 May, ten days before the start of the Dunkirk evacuation, the MAP came into existence.

The appointment of Beaverbrook was controversial at the time and his record at the MAP, where he stayed until 1 May 1941, has attracted comment ever since. He was noted for his unconventional management style, his often confrontational and sometimes ruthless way of dealing with others and for operating in a blaze of orchestrated publicity. Many senior figures, including politicians and RAF officers, were wary of him. Long after the war some senior RAF officers were still expressing resentment at the way his profile had overshadowed the AM's achievements in the procurement field prior to his, and the MAP's, appearance on the scene.[1]

The War Cabinet set Beaverbrook's immediate over-riding priority – the provision of the aircraft which might enable the RAF to defeat the imminent threat to Britain. He is best known for urgent and blunt

measures aimed at boosting the supply of Hurricanes and Spitfires during the Battle of Britain. However, even as France fell and the Battle of Britain raged, he also pursued initiatives which had no prospect of improving supply in 1940, but which were to prove beneficial later. One of these was production in the United States, under licence, of the Rolls-Royce (R-R) Merlin engine. In May 1940 the Merlin powered not only the Hurricane and the Spitfire, but also the Defiant, Fulmar and Whitley V amongst other types.

The scale of production demanded as rearmament accelerated in the 1930s was beyond the capabilities of Britain's 'professional' airframe and aero-engine industry. This resulted in the creation of 'shadow factories' run by engineering firms from outside the 'professional' industry. Many of the firms chosen to run shadow factories were from the motor vehicle industry, because it was felt that their experience of mass production could be harnessed in the aircraft sphere. One of the first 'shadow' schemes, initiated in 1936, was to produce Bristol aero-engines and involved five motor firms including Austin and Rootes.

R-R was resistant to involving other companies in Merlin production. At government instigation and expense, R-R itself put in hand two new factories (Crewe, in July 1938 and Glasgow, in June 1939) to supplement the Merlin capacity at its Derby works. However, this prospective extra capacity was still thought inadequate and in October 1939 the AM, believing R-R had its hands full, asked the Ford Motor Company of Dagenham to set up and run a third new Merlin factory.

The head of Ford UK proved highly co-operative and the scheme, located in Old Trafford, Manchester, proceeded quickly. Production started in September 1941and the plant eventually became the most efficient of the four Merlin factories in the UK.[2] (This was largely due to the retention of development and early production of new Merlin variants at the R-R run Derby and Crewe works while the Manchester plant concentrated on long runs of a limited number of established variants. A similar approach was to be adopted for production in the USA.)

The AM placed its first orders in the USA for aircraft, and associated engines, in June 1938. Other orders followed, but the volumes involved were relatively modest for various reasons, the most

fundamental of which was a failure to properly appreciate the supply potential of US industry.[3] From the start the Churchill government believed that Britain's survival and its ultimate victory depended on extra supplies of various kinds from the USA. Beaverbrook, a Canadian, was a regular visitor to the USA in the 1930s. Much of his wealth was invested in North America and he had influential contacts there. He recognised the huge potential of the USA as a source of supply in the aircraft sphere. Within weeks of taking office he was pursuing a range of possibilities which included manufacturing British aircraft types in America (which eventually came to nothing), substantially increased orders for American types and American manufacture of the Merlin.

Negotiations

Pre-war there had been approaches to R-R from American firms about licensing the Merlin for production in the US, but these proved inconclusive and nothing had been done to resuscitate the idea by the time the Churchill government was formed. During 1939 there had been extensive discussions between R-R and Ford, at the instigation of the French government, about production in France by Ford's French subsidiary. These discussions, which involved personnel from Ford's US HQ, also came to nothing.[4]

In late 1939 the British government established the British Purchasing Commission (BPC) in New York to co-ordinate its procurement activities in the USA under the capable Arthur Purvis, a prominent Canadian industrialist. President Roosevelt was sympathetic to helping Britain and France within the considerable political and legal constraints then prevailing in the USA. Purvis quickly managed to establish a close relationship with Henry Morgenthau, the strongly anti-Nazi Secretary of the Treasury, who had been charged by the President to deal with Allied requests for assistance.

Morgenthau was to play a major role in the Merlin story, together with William Knudsen, a senior figure from the US car industry and a member of the President's National Defence Advisory Commission. The Commission, established in early June 1940, was charged with accelerating the pace of the USA's own rearmament.

By mid-May 1940, at Churchill's instigation, Purvis was

investigating with Morgenthau the prospects of accelerating and increasing munitions supplies of various kinds from the USA. Thanks to Beaverbrook this list included US production of the Merlin.

The US was seeking to raise output of American military aircraft in the face of increasing security concerns, but its output of high-performance engines suitable for fighters was still modest which provided the rationale for a joint UK/US project to manufacture the Merlin. Morgenthau wanted to help Britain and was quickly persuaded of the potential merits of making it a joint project, if only as a stopgap for the Americans. On 21 May he cabled Beaverbrook directly asking that the US government be licensed to manufacture R-R engines in the USA.[5] The involvement of the US government in the project offered financial and other benefits for the British, so Beaverbrook readily agreed to a licence. This was done over the heads of R-R directors on a government-to-government basis, with the details left for subsequent clarification. R-R's US representative was left on the sidelines.[6]

By 27 May, thirteen days after taking office, Beaverbrook was corresponding with Sir Archibald Sinclair, the new Secretary of State for Air, about his intention to send a set of Merlin drawings to the USA.[7] On 28 May the MAP instructed R-R to send such a set. The lack of consultation with R-R directors about the course of events gave rise to justified concerns in the company that its commercial interests were being jeopardised.[8] It is evident that Beaverbrook's sole objective in the early weeks was to create momentum towards a deal in the US and he did not want R-R's own considerations to complicate this process.[9]

To add impetus to US sourcing matters Beaverbrook appointed a personal representative in North America, Morris Wilson, a respected senior Canadian banker and a friend. He airily instructed Wilson to 'go to Washington and deliver … the [Merlin] plans to the President forthwith… with a view to their immediate use for the production of aircraft engines'.[10] However, the discussions continued to be led by Purvis, with Wilson becoming a progress chaser for Beaverbrook on the spot.

Ford was seen by all, including R-R, as the best candidate for a licensing deal because of its size and expertise in mass production. Edsel Ford, son of the famous Henry and president of the company, was approached by Morgenthau on behalf of both governments. From

early June the discussions were led by the newly appointed Knudsen. The total initial requirement under discussion was 10,000 engines.

By 12 June 1940 Edsel had agreed to the principle and presented an outline proposition which Beaverbrook had agreed.[11] However, following the announcement of the deal to the press on both sides of the Atlantic, on 18 June, Henry Ford intervened, after an apparent change of mind. In what amounted to a political attack on Roosevelt, Ford senior, an isolationist anxious to avoid US involvement in the war, announced publicly that while he was prepared to manufacture Merlins for the US government he would not do so for the British. The administration was not prepared to proceed on that basis and on 27 June Morgenthau publicly rejected Ford's restricted offer.[12] (Henry evidently saw no contradiction between his stance in the US and allowing Ford subsidiaries in belligerent countries, such as the UK, to manufacture for those countries' governments.)

Therefore, in late June 1940, Knudsen turned his attention urgently to an alternative potential supplier – the Packard Motor Car Company. At its site in Detroit, Packard built luxury and mid-range cars of high quality, which often incorporated innovative technical features. As such, it was substantially smaller than Ford. Packard had got into aero-engine manufacture during the First World War (as had Ford) and continued in the field during the 1920s with its own designs. However, output had been modest and by 1931 Packard had ceased production of aero-engines. Since the late 1930s it had been building marine engines for US Navy PT boats based on one of its own V-12 aero-engine designs.[13] Pre-war it had been one of the US companies to make an inconclusive approach to R-R about a licence to manufacture Merlins. However, R-R had a high regard for Packard's engineering expertise.[14]

Knudsen pursued urgent discussions with Packard's top management which was immediately attracted by the opportunity. Beaverbrook maintained pressure for progress via Wilson. On 13 July 1940, three weeks after Packard had been approached and two months after Beaverbrook's appointment, the Wall Street Journal announced a preliminary agreement between the company and the British and US governments. Production was to start within ten months of contract signature at a rate of 20 engines per month rising to 840 per month after 15 months. (At the time total UK Merlin production was running

at 740 per month.) The initial order was for a total of 9,000 engines, of which 6,000 were to be for the British and 3,000 for the US government. The value of the deal was put at $150 million.[15]

Over subsequent weeks Knudsen and Purvis co-operated closely in the process of translating the preliminary agreement with Packard into full contracts. Packard's board negotiated on a strictly commercial basis. It pursued, and got, provision of substantial finance to pay for the creation and equipment of the Packard Merlin production plant and arrangements which guaranteed comprehensive compensation in the event that the UK contract came to a premature end (by this time, France had fallen and Britain was under threat of invasion). The bulk of these financial undertakings fell ultimately on the British government, as the major customer in the deal. In addition, there was considerable discussion of the prices which Packard was to be paid for the engines it produced.[16]

On 3 September 1940, as the Battle of Britain approached a climax, Packard signed a contract with the British government and, the following week, one with the US government. The two governments' initial orders were to run concurrently with the British entitled to two thirds of monthly output and the Americans the other third.

R-R was not a legal party to these contracts and had no financial interest in them. Its intellectual property had been 'appropriated' by the British government, without financial recompense, in the interests of the war effort.[17]

The Technical Challenge

The Merlin was a centrifugally supercharged V-12 in-line liquid-cooled engine consisting of some 14,000 parts. In 1940 it represented leading-edge technology. Its nearest American equivalent – the Allison V-1710 – was less complex, but offered inferior performance at higher altitudes.[18]

R-R directors were in a difficult position. Although the company had no formal standing in the contracts, they concluded that the US project would fail without R-R's technical input, an outcome they could not countenance. R-R's Technical Director warned Beaverbrook that getting from a set of drawings (prepared to British engineering standards) to high-volume production would be a major challenge,

even for an experienced engineering company.[19] Packard management, too, realised from the start that very close co-operation with R-R would be essential and requested the transfer to Detroit of R-R staff.

Therefore, in early July 1940, before even a preliminary agreement had been reached with Packard, Beaverbrook authorised the seconding to the MAP of three senior R-R engineers and their urgent despatch, as resident liaison engineers, to Detroit. The three, between them, offered expertise in the design, development, and production aspects of the Merlin. They included the aero division's Chief Designer and its Chief Experimental Engineer, and their departure weakened R-R at a critical time. The three were at Packard by early August. In October 1940 a senior MAP official was sent to the USA to help expedite both commercial and technical aspects of the project. The latter returned to the UK after a year, but the R-R men stayed on, the last to return coming home in 1945. Their contributions drew subsequent tributes.[20]

In the interests of future interchangeability between UK and American-produced Merlins it was agreed that Packard would retain British screw and pipe threads. In the short term this decision added considerably to the difficulties of getting production underway, because these threads were virtually unknown in the USA and the cutting and rolling equipment for their manufacture would have to be imported from the UK or custom-made in the USA.

A full set of Merlin drawings consisted of over 2,000 blueprints. Dimensional tolerances were frequently omitted from the R-R drawings because they conformed to general UK practice or, where they were shown, were often departed from on account of accepted variation known to R-R staff. There were also national differences in material specifications and engine accessories. Therefore, all the blueprints had to be redrawn to make them useable for Packard purposes and some subsequently modified in the light of a continual flow of modifications emanating from R-R.[21]

Notwithstanding differences between British and American engineering practice, it was integral to the project that the standard of all Packard output was equally acceptable to both its customers. This was achieved through delicate technical discussions between the R-R representatives, Packard and the US inspection authorities.

It was envisaged that Packard would manufacture the then latest

production variant of the Merlin, the Merlin XX, which powered the Hurricane II amongst other types. However, the opportunity was taken to make the first Packard variant – designated the Merlin 28 by the British – an improvement on the XX. It differed primarily in having a two-piece, rather than single-piece, cylinder block, designed by Packard.[22] (Two-piece blocks had advantages, notably a greater tolerance to higher boost pressures. The first Packard variant was closely equivalent to the Merlin 22, which had a R-R designed two-piece block and started coming off UK production lines in 1941.) Other technical differences between UK and Packard-built Merlins were minor. However, for supply chain convenience, the latter were fitted with US-made magnetos, carburettors, fuel pumps and other engine accessories.[23]

The key to the ultimately prodigious progression in Merlin performance during the war was supercharger technology. Early Merlin variants, which powered aircraft such as the Hurricane I and the Spitfire I, had single-stage superchargers of the relatively simple single-speed type. However, the XX and the Packard 28 variants had single-stage superchargers of the more advanced two-speed type. The next big advance in superchargers came with the introduction of the still more complicated two-stage two-speed models; Merlins incorporating these went into production in the UK in December 1941.[24] Initially, UK and Packard superchargers were extremely similar. However, a difference emerged with two-stage models, with Packard employing a different type of gearing for the supercharger drive.

In parallel with the resolution of a myriad of technical issues, Packard was constructing, equipping and staffing its new Merlin production facilities in Detroit. As in UK shadow factories, there was considerable use of unskilled female labour in the production process, made possible by high levels of process automation. Packard was also establishing a substantial domestic supply chain to provide it with parts, some assembled components and supplies of engine accessories.

The first (handmade) Merlin 28s were demonstrated publicly on test stands in Detroit on 2 August 1941, eleven months after the contract had been signed. Output from the production line was a mere trickle in the early months, with just 60 produced by the end of 1941, but started to rise quickly during the first half of 1942 as experience

grew and bottlenecks were overcome. (The recruitment and training of the workforce proved a constraining factor, as did the flow of manufacturing equipment, despite the Packard project receiving a high priority classification from the US government.) [25]

Later, Packard production was switched to equivalents of some of the improved Merlin variants developed by R-R in the UK. These included the Merlin 38 and 224 which retained single-stage two-speed superchargers. By 1943 Packard was also producing variants with the more advanced two-stage two-speed supercharger.

The quality of Packard Merlins proved to be very high. Technical problems were similar to those suffered by equivalent UK-produced Merlins. Overall, there was nothing to choose in reliability terms between UK and Packard produced engines.[26]

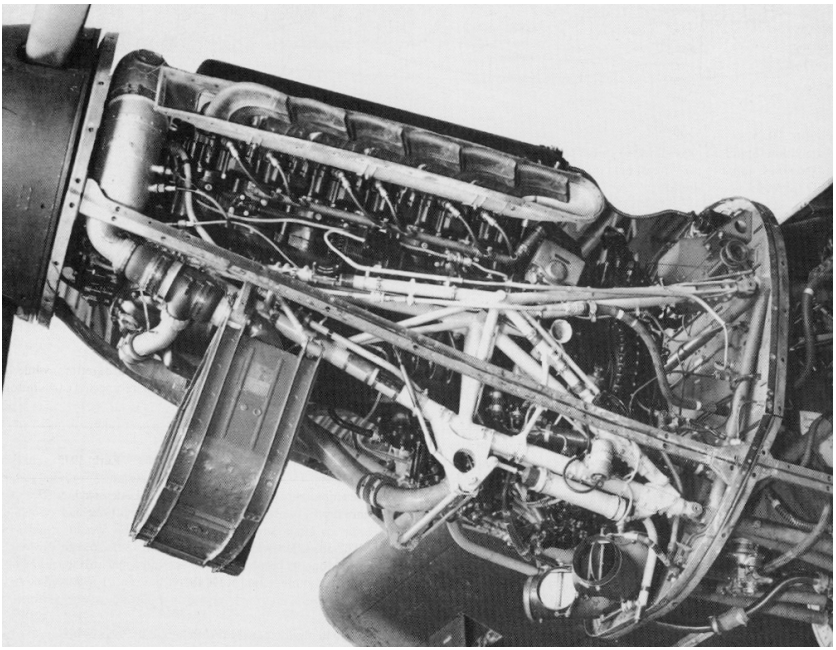
The Results

After a slow start (which mirrored experience at Ford's UK plant), monthly output reached 700 units by June 1942. By October it had hit 800 and cumulative total output stood at 5,080.[27] Monthly output continued to rise, averaging 1,100 in 1943.

Rising output in Detroit was reflected in a significant flow of Merlin 28s to the UK from mid-1942 onwards – by the end of the year 3,300 had arrived. This was very timely as, despite growing output from the four UK Merlin factories, a shortage of UK-produced engines was emerging in the face of ambitious plans to escalate heavy bomber output.[28]

In the UK Packard engines were used solely in the Lancaster for the first two years, production of the Packard-powered Mk III commencing in November 1942. The fitting of Packard Merlins to other types in the UK, including the Halifax and the Mosquito, was considered, but rejected.[29] Eventually, from September 1944, the Packard Merlin 266 (which had a two-stage supercharger) was adopted for some Spitfire IXs. A total of 1,054 Spitfire XVIs (ie the Packard-engined Mk IX) were built. They were used by the RAF in northern Europe in the ground-attack role.[30]

The marriage in the UK of the Packard Merlin to just one predominant type – the Lancaster – made for supply chain simplicity and helped to maximise output of the most capable of the RAF's heavy bombers. The Lancaster III used, in succession, the Packard-



The first Packard Merlin installation in Lancaster W4114 in October 1942, making it the prototype Mk III. (Rolls-Royce Heritage Trust)

built Merlin 28, 38 and 224. A total of 3,460 Packard-powered Lancasters were produced (including 430 in Canada), representing 47% of total Lancaster production (7,377).[31]

British policy was to diversify aircraft supply by developing production of British types in the Dominions. As a result, starting in 1942, some of the UK government's allocation of Packard output was sent directly to Canada where it was fitted to Hurricanes initially, and then to Mosquitos and Lancasters being built there. Later, some of the UK's allocation was also sent directly to Australia for fitting to locally produced Mosquitos.

Total wartime Canadian and Australian production of these Packard-powered aircraft amounted to some 2,700 machines, including 1,100 Mosquitos and 1,100 Hurricanes. The Mosquitos represented 17% of total wartime production of the type with many being ferried to the UK for RAF use.[32] Most of the Hurricanes went to the RCAF.[33]

US Demand for the Merlin

When the project started the MAP thought it likely that the UK would get the benefit of all Packard production once the initial order for the US government had been fulfilled. However, events were to dictate otherwise – the entry of the USA into the war in December 1941 and the effectiveness of the Merlin in American aircraft led to further substantial US demand. This, and increased British demand, led to more orders and the installation of more capacity at Packard. Packard had received its first follow-on order, for 14,000 engines, by early 1942.[34]

By the end of the war Packard production for the British and the Americans totalled some 55,000 units. With wartime UK production of Merlins reaching about 100,000, Packard accounted for some one-third of all wartime Merlins produced.[35]

Initially, the US government's share of production was used for the Curtiss P-40, the most capable of America's single-engined fighters early in the war. The fitting of the Merlin (known as the Packard V-1650 by the Americans), instead of the Allison V-1710 engine, improved the P-40's performance significantly, especially at altitude. Over 2,000 Packard-engined P-40 Warhawks were produced and saw widespread action outside the European theatre.[36] Some 300 were delivered to the RAF as the Kittyhawk II.

In 1942 a two-stage supercharged Merlin was fitted experimentally in the British-inspired North American P-51 Mustang, instead of the V-1710. This famously transformed the type into probably the best all-round single-engined fighter of the war. Therefore, from 1943 onwards, an increasing proportion of the US government's share of Packard output was allocated to Mustang production. Some 13,600 Merlin-engined Mustangs were produced, of which more than half were the P-51D variant.[37] The Merlin Mustang saw extensive service in all theatres. In northern Europe it was notable for its role in the Allied strategic bombing campaign by escorting USAAF daylight raids into the heart of Germany.

Conclusion

Beaverbrook's involvement in the US production of Merlin engines is relatively little known. His efforts to boost short-term aircraft production during the Battle of Britain, regardless, apparently,

of longer-term consequences, provide the dominant narrative. The Merlin story demonstrates that his focus was not entirely short term – he knew that there was never any prospect of US-made Merlins becoming available until well into 1941. As well as recognising the opportunity remarkably quickly and driving through the deal, he ensured that the scarce technical resources necessary to make it a success were made available, even as Britain fought to remain in the war.

The Packard deal proved to be an even better one than Beaverbrook could have imagined – by enabling the production of 22,000 Lancasters, Mosquitos, Hurricanes, Spitfires, Mustangs and P-40s it was to make a significant contribution to Allied air power and, therefore, to ultimate victory.

Notes:

[1] See, for instance, Slessor, MRAF Sir John; *The Central Blue: Recollections and Reflections* (London; Cassell; 1956), p307 and Douglas, Sholto with Wright, Robert; *Years of Command* (London; Collins; 1966), p118.

[2] The development of the shadow aero-engine industry is described in the narrative 'Aero-Engine Production: Expansion of Capacity, 1935-45.' (TNA CAB 102/53).

[3] Slessor conceded as much, *op cit*, p309.

[4] Pugh, Peter; *The Magic of a Name, The Rolls-Royce Story: The First Forty Years* (Duxford; Icon Books; 2000) pp210-211, 231-232.

[5] TNA AVIA 38/4. Purvis to J. Monnet (Anglo-French Co-ordinating Committee), 21 May 1940 (PURCO No 133).

[6] Hall, H Duncan; *North American Supply* (London; HMSO & Longmans; 1955) p19. Also TNA AVIA 38/92 – J McManus (Attorney for R-R in US) to Purvis, 31 May 1940; Purvis to McManus, 6 June 1940 and 6 July 1940.

[7] Beaverbrook Papers (in Parliamentary Archives at the Palace of Westminster), BBK/D/21. Beaverbrook to Sinclair, 27 May 1940.

[8] Pugh, p210.

[9] In his letter to Sinclair of 27 May 1940 Beaverbrook stated that he had objected to a team from R-R, led by its Managing Director, going to the US.

[10] Cited in Pugh, p209.

[11] TNA AVIA 38/5. Purvis to Monnet, 11 June 1940 (PURCO No 190) and 12 June 1940 (PURCO No.197).

[12] TNA AVIA 38/92. Sir Henry Self (BPC) to A Rowlands (MAP), 28 June 1940; Lord Lothian (UK ambassador to USA) to Lord Halifax (Foreign Secretary), 1 July 1940.

[13] This activity continued throughout the war. They were also ordered by the Admiralty for fitting in MTBs for the Royal Navy.

[14] Pugh, pp210-211.

[15] TNA AVIA 38/92. Wall Street Journal cutting, 13 July 1940.
[16] *Ibid*. Note of Meeting with Packard Officials, 11 July 1940; H Bodman (Attorney for Packard) to Sir Henry Self (BPC), 18 July 1940; Purvis to Knudsen, 31 July 1940 and 19 August 1940.
[17] TNA AVIA 38/419. M Olley (R-R's US representative) writing to A Baker (BPC), 10 April 1941, described what happened as 'appropriation'. The British government eventually indemnified the US government against any claim from R-R for using its designs and patents. [Ashworth, W; *Contracts and Finance* (London; HMSO & Longmans; 1953), p56].
[18] Allison was a division of General Motors, of which Knudsen had been President.
[19] Ernest Hives to Beaverbrook, 8 July 1940, cited in Pugh, p211.
[20] Pugh, pp233-234, 300-301 & 317.
[21] TNA AVIA 38/786. M Gilman (President of Packard) to Knudsen, 22 August 1941.
[22] Harvey-Bailey, Alec; *The Merlin in Perspective – the Combat Years* (Derby; R-R Heritage Trust; 4th Edn 1995) pp77 & 143.
[23] TNA AVIA 38/786. Table listing engine accessories for Packard Merlins, 14 August 1941.
[24] Effectively two superchargers in series, with a liquid-cooled intercooler to prevent the air/fuel mixture getting too hot.
[25] TNA AVIA 38/786. Gilman to Knudsen, 22 August 1941; J Reid (R-R resident engineer, Packard) to C Fairey (British Air Commission), 25 November 1941.
[26] Harvey-Bailey, p77.
[27] TNA AVIA 10/385. Review of USA Engine Production, Table 2, 6 April 1943.
[28] TNA AVIA 10/376. Narrative, 'Packard Merlins', p7. A Cairncross papers. Undated, but late 1944 or after.
[29] *Ibid*, p8.
[30] Green, William; *War Planes of the Second World War: Fighters Vol 2* (London; Macdonald; 1961) p106.
[31] Jacobs, Peter; *The Lancaster Story* (Wigston; Silverdale Books; 2002) p173.
[32] Green, William *Famous Bombers of the Second World War* (London; Macdonald; 1959) pp120-122. Wartime Mosquito production totalled 6,710.
[33] Green, William; *Famous Fighters of the Second World War* (London; Macdonald; 1957) p24.
[34] TNA AVIA 10/376. 'Packard Merlins', p3; AVIA 10/385. Review of USA Engine Position, 14 April 1942.
[35] Pugh, p227; Harvey-Bailey, p.13. Interestingly, the Ford plant in Manchester produced over 30,000.
[36] Green, *op cit*, p48.
[37] *Ibid*, pp96-98.

GUNS IN THE SUN AND SNOW

The RAF in Southern Russia 1918-1920

Air Cdre Phil Wilkinson

2015 is a year for anniversaries, especially centenaries. 800 years since Magna Carta; 600 since Agincourt; 200 since Waterloo; 100 years since the registration of the design for the *Coca-Cola* bottle; and – to declare an interest – 100 years since the formation of No 14 Squadron (and 20 or more generally less notable outfits!). Also, for the non-centenary enthusiast, 50 years since the Budget Day cancellation of TSR2; 75 years since the Battle of Britain; 70 since the liberation of Auschwitz and the end of the War in Europe.

Russia, and some of the other republics of the former USSR, will make much of those last two. Despite current difficulties over Ukraine and Crimea, Russia's mood of engagement with former Allies from the Second World War has been carefully developed over the 25 or so years since the collapse of the Soviet Union. Commemorative medals, to mark the centenary of the end of the War in Europe (the 'Great Patriotic War'), have been awarded to veterans of the Arctic convoys of 1941-45 (including to those RAF men who went to Russia on the very first in August 1941.[1] This has been a sequence, with the first in 1985 and the most recent award in 2010. Another is planned for this year. More recently, after the British Government relented and sanctioned the award of a specific campaign medal, the Arctic Star, for service in and over Arctic waters, Russia has awarded a full gallantry medal (the Ushakov Medal) to those few hundred living convoy and Arctic service survivors – including Royal Navy, Merchant Navy, and Royal Air Force veterans.

Since 1999 there has been a Soviet War Memorial in Britain. It stands in the Geraldine Mary Harmsworth Park in Southwark, a few yards away from the entrance to the Imperial War Museum. Ceremonies are held there three times a year: on Remembrance Day, Holocaust Day, and on Victory Day – which is 9 May for the former Soviet Union, based on the date and time of the signature of German surrender in Berlin in 1945. These ceremonies involve wreath-laying by diplomatic and military representatives of former Soviet republics, and of Second World War Allies, by the local MP, local government

officials, and – most importantly – by veterans' organisations. Recent years have seen several hundred spectators joining the participants.

But with this steady focus on the Second World War, and recalling the recent unveiling in the centre of Murmansk of a memorial to the sacrifice of British and other Allies during the convoy campaign, we might forget that the 1941-45 convoy system was not an innovation. For in 2015 there will be another centenary to reflect on – the November 1915 departure of a re-supply convoy from Scapa Flow to Murmansk, escorted by the armoured cruiser HMS *Donegal*. The background and the imperative for a supply mission to Russia in 1915 was almost exactly the same as in 1941. Continuation of German efforts on their Eastern Front served to dilute their potentially fatal pressure on British and allied forces in the West. By 1915, Russia had lost over two million men and was desperately short of munitions. Britain and France, desperate to keep Russia in the fight, were despatching supplies to the northern Russian ports of Murmansk and Archangel, and also to the Siberian east via Vladivostok.

But what started as a logistic support operation became the victim of mission creep, or – realistically – victim of the way the world turns. Fortunes of war, plus the revolutionary atmosphere in Russia, meant that the entire Allied effort (Britain alone was shipping an annual three million tons of military stores by the beginning of 1917) could not halt a Russian exit from the War. Now came the need to protect those stockpiles at the Russian ports: Germany could make use of them as it turned away from its eastern campaign. But what started as a protection operation slowly rolled over into a counter-revolutionary strike against the Bolsheviks, with British forces engaged across Russia – north, south, east, and west. And this was developing, almost incredibly for those involved, as the Armistice was signed in November 1918.

The story of that departure from a fair number of the Principles of War requires more space than is allowed here. But it is worth remembering, before turning to what was happening in the southern parts of Russia, that along that road in Murmansk, just a relatively few yards from the recently-unveiled memorial to the sacrifice of British servicemen in 1941-45, there stands another. It is to the victims of foreign aggression, during the 'Intervention' of 1918-1920. Britain probably has the biggest responsibility for those victims, and British

airmen not least. They were just as active, and just as lethal, down south.

The Day We Nearly Bombed Moscow is the title of a book that captures the RAF's potential for operational 'reach' during their southern Russian deployment.[2] How so?

In the space allotted to me by the Editor I cannot provide a fully annotated and 'academic' account of every single piece of all the operational activity of the RAF in southern Russia. But, in a series of vignettes and extracts from official and unofficial sources, I shall hope to capture the extraordinary flavour of a period in our Service's earliest days, and – along the way – point towards the further reading that will take the reader deep into the tribulations, and occasional jubilations, of combat in an undeclared war. It will be a brisk digest of some of the more memorable elements of some typical wartime life – those endless periods of boredom and inactivity, broken by occasional moments of shock and awe. There will be references back to contemporary or near contemporary reporting – and this will mean the occasional confusion of ranks and titles. In the early days after the formation of the Royal Air Force, old RFC and RNAS terms were often still used. This was very much the case in the further theatres of war, especially those still 'at it' long after the end of hostilities in November 1918.

So, back to the day the War ended – 11 November 1918, and the signing of the Armistice. Lots of justified relief and celebration across the home islands. Up in the Orkneys, the bells rang out in St Magnus' cathedral in Kirkwall. From Royal Navy ships in the close harbour, in Scapa Flow, and further out at sea, massive salutes were fired. But one ship load of troops – mainly from the Yorkshire Regiment, and nearly 3000 all told – was in far from celebratory mood. They were cooped up awaiting sailing orders for their journey to Murmansk. Their next few weeks or maybe months – it wasn't clear for how long they were being deployed – held the prospect of fierce fighting in the bitter Arctic winter. British forces – land, sea, and air – had been in action in and around Murmansk and the Kola Peninsula since May 1918, and up the River Dvina from Archangel since August. Although those Yorkshiremen didn't know it, they and their colleagues would not leave Russia until October 1919. Which is why so many village war memorials bear the date 1914-1919. Some even have 1914-20 – and

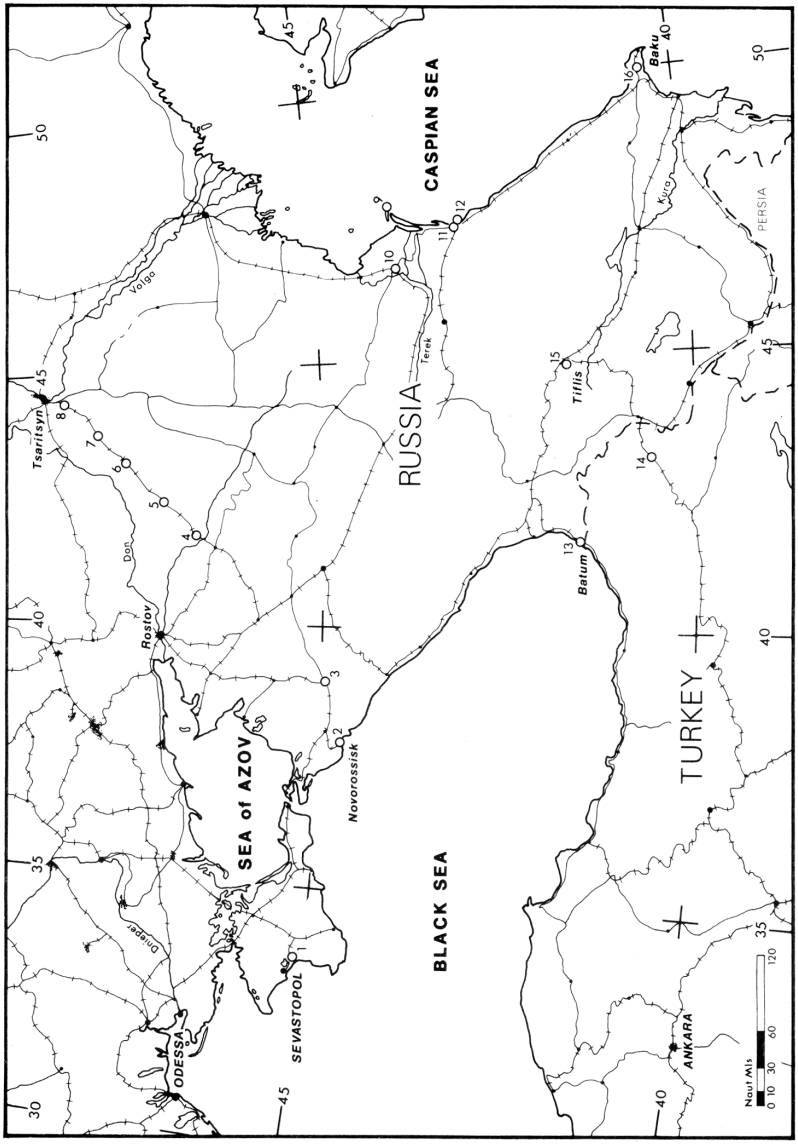
that is because of what was going to happen in the south.

The British Government was attempting to manage all the implications of the Armistice and the end of major hostilities. At a Foreign Office meeting on 13 November, the Chief of the Imperial General Staff, Sir Henry Wilson, tabled a paper which had three options: withdraw all British forces from Russia, while attempting to create a *cordon sanitaire* to protect western Europe from the expansion of Bolshevik ideas; take full military action to crush Bolshevism in its homeland and thus generate a politically acceptable Russia to hold German eastern ambitions at bay; and thirdly, merely offer material help to the 'friends', and then withdraw. The friends? These were the so-called White forces, a mixture of the Imperial faithful, in slightly uneasy alliance with the regional Cossacks, and under the leadership – in the south – of General Denikin (formerly Commander-in-Chief of the Imperial South-Western Front).

The discussion noted that Wilson's first two options were either militarily impracticable, or politically unacceptable, or both. So the next day the War Cabinet endorsed a set of decisions, building on Wilson's third option:

- To remain in occupation of Murmansk and Archangel
- To retain the battalions and military missions in Siberia and encourage Canada to retain her troops there. To try to persuade the Czechoslovak Corps to remain at the front in Siberia rather than seek repatriation. To recognize the Directorate at Omsk as the *de facto* government of Siberia.
- To establish contact with General Denikin in South Russia and give him all possible assistance.
- To occupy with British troops the railway running from Batum on the Black Sea to Baku on the Caspian.
- To supply the Baltic states with military materials should they appear to be able to make effective use of such assistance.[3]

Of note, of course, is the identification of international players in this Russian story, all across the territory. Americans were involved, as were Japanese, Australians, and Canadians, plus French, and Italians, and Greeks. But the air combat in the south was very much a British affair; indeed, the first deployment of British air assets into the



1 Saki
2 Novorossisk
3 Ekaterinodar
4 Velikoknyajaskaya
5 Zimovniki
6 Kotelnikovo
7 Gniloaksaiskaya
8 Beketovka
9 Chechen
10 Lagan
11 Petrovsk Kaskar
12 Petrovsk Port
13 Batum
14 Kars
15 Tiflis
16 Baku

South Russia, showing a selection of locations that featured during the RAF's involvement .

Caucasus had been in August 1918, in support of 'Dunsterforce'.

Dunsterforce? This was the adopted title of a series of expeditionary probes into the southern Caucasus, under the command of Maj Gen Lionel Charles Dunsterville[4]. They had begun in early January 1918, and were the leading edge of British (and Allied) responses to the difficulties that would be posed by the exit of Russia from the war. Armistice (between Soviet Russia and the Central Powers) was signed on 15 December 1917. Peace negotiations began at Brest-Litovsk on 22 December. The Allies mulled all this over, and it was going to be a British responsibility since a 'spheres of influence' and responsibility zones agreement, signed on 23 December 1917, had given France areas west of the river Don, and Britain the Caucasus and areas north and east of the Caspian.

So, on Christmas Eve 1917, Maj Gen Dunsterville (on garrison duty with the Indian Army's 1st Infantry Brigade on the North-West Frontier) was issued '. . . secret orders to report at Army HQ at Delhi, with a view to proceeding overseas on special work.'[5] I can do no better than to go into the opening chapters of his own record and quote from him directly, as he sets out the precise reason for his summons.

> 'One of the big items in the deep-laid pre-war schemes of Germany for world-domination was the absorption of Asia Minor and the penetration into further Asia by means of the Berlin-Baghdad railway. When Baghdad was taken by the British in March 1917, and the prospect of its recapture by the Turks appeared very remote, the scheme for German penetration into Asia had to be shifted further north and took the obvious line Berlin-Baku-Bokhara.
>
> In this latter scheme it was evident that the Southern Caucasus, Baku and the Caspian Sea would play a large part; and the object of my mission was to prevent German and Turkish penetration in this area.
>
> Fate ordained that, just at the time that the British thwarted the more southern German scheme by the capture of Baghdad, the Russian breakdown opened the northern route to the unopposed enterprise of the Germans. ……. Tiflis *[now Tbilisi]*, the capital of the Southern Caucasus, was likely to fall without serious resistance into the hands of the enemy, and the

capture of this town would give the Turko-German armies control of the railway line between Batoum *[now Batumi]* on the Black Sea and Baku on the Caspian, the enormously valuable oilfields of Baku, the indispensable minerals of the Caucasus Mountains, and the vast supplies of grain and cotton from the shores of the Caspian Sea.

The scene of conflict being too far removed from any of the main areas of the war – Baghdad to Baku is 800 miles – it was quite impossible to send sufficient troops to meet the situation.

The only possible plan, and it was a very sound one, was to send a British mission to Tiflis. This mission, on reaching its destination, would set to work to reorganize the broken units of Russian, Georgian and Armenian soldiery, and restore the battle line against the Turkish invasion. The prospects were considerable, and success would be out of all proportion to the numbers employed or the cost involved. It was attractive and practical.

The honour of command fell to my lot, and I set forth with the leading party in January 1918.'

His 320-page record,[4] is a very good read, although the modest air contribution gets only brief mention. That air element came into play during the second phase of the operation, after a first abortive attempt to get from Baghdad to Baku in January 1918 was frustrated at the Caspian port of Enzeli, where the Bolshevik authorities sent them back down the road (helpfully supplying the fuel for their collection of Ford cars and vans). The 55-strong party set up a new HQ at Hamadan, in northern Persia, about halfway back to Baghdad, and the numbers were steadily augmented by the addition of a number of small contingents of ground troops, plus a Martinsyde G100 Elephant from B Flight of No 72 Sqn. So equipped, Dunsterville felt able to move his HQ back again, further north to Kasvin, just 90 miles short of Enzeli. The old adage about plans and first contact with the enemy came into play about now – April-May 1918 – and the target was changed from Tiflis, via Baku, to simply Baku, to which the Turks were now advancing rapidly. The next few months saw a variety of what would now be hailed as examples of 'jointery' and improvisation. Naval guns were shipped overland (shades of similar

efforts during the Boer War) and installed aboard commandeered merchant vessels, thus creating the Royal Navy's Caspian Flotilla, under command of Cdre David T Norris. He and Dunsterville were in close harmony for the crossing to Baku, and the 72 Squadron aircraft (by now two of the Martinsydes) were dismantled and shipped across from Enzeli to Baku. They operated in reconnaissance, leaflet dropping, and bombing roles. Historical Society Journal 48 has Guy Warner's account of RFC/RAF actions in Mesopotamia, including this Black and Caspian Seas operation. Suffice to say that the two detached 72 Squadron pilots were decorated for their part in this small piece of air force combat history. As a Supplement to the *London Gazette* of 15 July 1919 had it:[6]

> 'The King has been graciously pleased to approve of the undermentioned awards of the Distinguished Flying Cross, conferred by the General Officer Commanding the British Army in Mesopotamia:-
>
> Lieutenant Moray Sutherland Mackay, 72nd Squadron.
> Lieutenant Ralph Patrick Pope, 72nd Squadron (E Surr R).
>
> During the operations at Baku between 25th August and 13th September, 1918, they flew continuously over the enemy's positions, bombing and machine-gunning from low altitudes with great effect, in the face of very vigorous fire from the enemy throughout the whole period.'

Much more developed – in both roles, missions, and equipment – were the operations of three more squadrons, all operating on or over the Black and Caspian Seas until 1920. In numerical order, this means a first look at No 47 Sqn. When the Armistice was signed its members were operating against the Bulgarians in Macedonia. In London, as outlined above, support for the White Russians, and especially for their commander in the south, General Denikin, was taking shape in the planning staffs. Denikin had been active during the late summer of 1918, and had advanced across the Don region, moving southwest to advance on and eventually capture the Black Sea port of Novorossiisk on 25 August. This port would then serve as the entry point for the Allied aid that would start to flow in November. Denikin now established his HQ at Ekaterinodar (*now Krasnodar*), 60 miles inland

from the port. A large British military mission, led by Maj Gen Frederick Poole (who had been in overall command of the Allied intervention forces in north Russia, until disagreement with the Americans over his alleged inappropriate political manoeuvring), arrived in early December and joined the Denikin HQ. By February, Poole had been replaced by a Maj Gen Briggs, and an air component commander had arrived – a Lt-Col Maund.[7] It was immediately clear to him that there was little he could do to help the White Russian air services. They were ill-equipped and lacking in enthusiasm. The aim had never been for any British units to engage in combat; they were there to train and advise. This was the defined mission of the tank training school – also set up at Ekaterinodar, equipped with British light tanks shipped out from England – but the trainers had soon found themselves drawn into operations, and this was to be the case with the air component. Maund's original role was to supervise a training school, to be equipped with 50 or so RE8 aircraft. But they lost their place in the shipping queue, and Maund – in near desperation – urged the transfer of an operational unit to bolster the Russians' air potential. This was the impetus for the transfer of No 47 Sqn to Russia, although only half the squadron made the move, with full complement made up by adding a flight from No 17 Sqn. Coincidentally, the next major RAF deployment to Russia, in August 1941, found No 134 Sqn forming from a flight of No 17 Sqn. *Déjà vu* all over again.

On 16 April 1919, the first nine aircrew officers and two engineer officers were told off to leave their base at Amberkoj and sail for Novorossiisk. Two weeks later a follow-on contingent left Salonika and sailed for Russia. The acting command of the squadron was held by Capt S G Frogley, hitherto of 'A' Flight, 17 Squadron.[8] Full command was about to be taken by Capt (Temp Maj) R Collishaw. He was a Canadian and a highly successful RNAS fighter pilot with some 60 air combat victories over the Western Front, and a distinguished career ahead of him with advancement to air rank and Group command in the Second World War. Maund's call for active service from an air echelon meant that the non-volunteer status of the unit would have to be modified. Maund had written:[9]

> 'Considerable difficulties were experienced, owing to the men being war weary and eager to return home for demobilisation,

and Russia in its condition was hardly the place for discontented Men.'

In fact, Collishaw found no shortage of volunteers as he toured UK in that late spring of 1919. Much the same had been the case as the air component for the Allied intervention in north Russia was being assembled in 1918. Ira Jones recalled the heady atmosphere in London, as old comrades met each other at the RAF Club and made sure each knew the opportunities for more flying and fun. Jones himself was easily persuaded by 'Beery' Bowman, and tells an exhilarating tale of what happened next, in Archangel.[10] Thus, by late April, Collishaw had gathered some 260 men (including ten officers) and travelled across Europe by train to Brindisi, then by sea across to the Dardanelles, past Constantinople, and over the Black Sea to arrive in Novorossiisk on 8 June 1919. The group moved forward to Ekaterinodar, and two days later an advance party left by train – with dismantled aircraft on flatbed trucks – to move up to the front around Tsaritsin (later to be named Stalingrad, and later still Volgograd). The state of the ground battle at this time was best expressed as 'fluid'. The Whites were seeing the tide turn in their favour, although still under heavy pressure from the Bolshevik Reds. Cossack troops had driven the Reds back along the Don and General Wrangel's Caucasian Army had decimated the Reds' 10th Army and pushed it back towards Tsaritsin. Support for the forthcoming White offensive would be the primary role for the men and machines of No 47 Sqn.

But their move up to the front was entirely at the mercy of the inadequate rail network. It took ten days for the train carrying that advance party (C Flight) to get up the line as far as Gniloakaiskaya, just over 300 miles from Ekaterinodar. Five aircraft – all DH 9s – set off also on 10 June and their fortunes were mixed. While four made it to a half-way house at Velikoknayeskaya, the fifth made it only as far as Dinskaya, only 20 miles along the route. The story of its recovery bears reading – the enterprising equipment officer Lieutenant Dumas, plus a small team, salvaged the machine and got it back to base after effectively disrupting the rail network of southwest Russia for a day and a half.[11] The main train party moved ahead to Zimovnika, but that took another day and a half. The four serviceable aircraft were intended to leapfrog and advance to Kotelnikovo, but awaited news of

the train's progress. The retreating Reds had smashed a number of bridges and the train did not arrive in Kotelnikovo until 16 June. The ground was cleared as well as possible to provide a decent landing strip next to the station, but one aircraft broke its undercarriage on landing. Then the rain set in, and although the three serviceable aircraft were bombed up, there was no operational flying until 22 June. In the meantime, however, the salvaged DH 9 arrived (Lts White and Webb on board) and the entire team flew forward to join the train team at Gniloakaiskaya. One more landing accident reduced the complement to four, and on 22 June their first mission was launched. The Reds were pushing the Whites back and the new airfield was threatened. Despite the four crews' eagerness to get at the enemy, the weather had other ideas and they had to turn back. On the following day the game was on again:

> 'Three machines left at 10.30 a.m. with sixteen 20-lb. and two 112-lb. bombs. The objective was the South-Eastern railway station at Tsaritsin. The machines arrived safely and bombs were dropped from a height of 5,000 feet, doing damage to the station buildings, rolling stock, and neighbouring houses. In addition about a 1,000 *(sic)* rounds were fired into barges on the Volga, the station, on streets, and on some cavalry near Elshanka.'[12]

Leading this raid was the C Flight commander, Capt H G Davis. He led another three-ship attack on 24 June, when the targets were barges on the Volga, and buildings around the railway station. River traffic was to remain a target since the Reds were bringing basic logistic supplies and also gunboats or armed riverboats up the river from Astrakhan. Over the next five days at least a dozen bombing and/or armed reconnaissance sorties were flown. The Reds were withdrawing from Tsaritsin and being chased to the northeast, with considerable contribution from the squadron's limited resources.

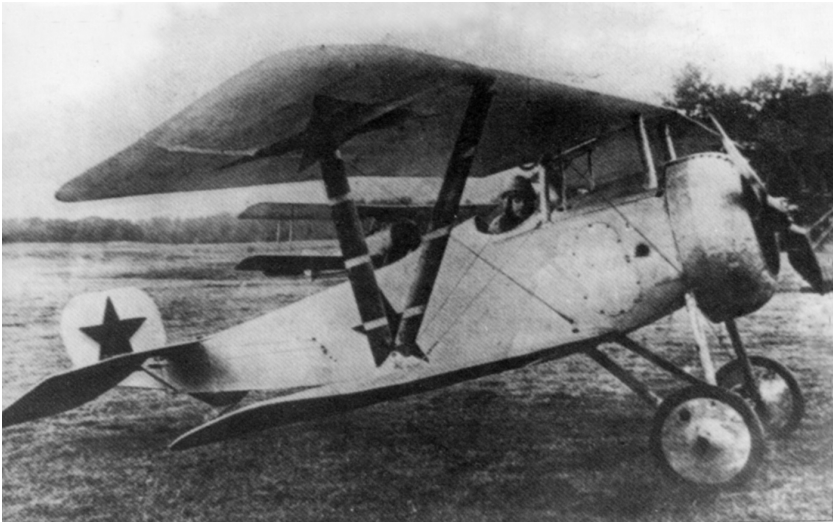
With this withdrawal now appearing to be definite, C Flight moved forward to a landing strip at Beketovka, in the southwest suburbs of the greater Tsaritsin area (it would later be the location for General Paulus' incarceration when the German 6th Army was defeated at Stalingrad in 1943). The new base was operational from 6 July, but initially only with three aircraft since Lt Reynolds had to make a

forced landing shortly after take-off from Gniloakaiskaya. Targets now would continue to include river traffic plus longer range attacks against the retreating Reds 120 miles northeast at Kamishin, together with logistic parks at Tcherni Yar, down the Volga towards Astrakhan.

On 11 July, Maj Collishaw moved up from Novorossiisk to the main HQ at Ekaterinodar, accompanied by seven officers and 179 other ranks. There had been great effort devoted to assembling and repairing aircraft shipped into theatre, thus helping to keep C Flight up to strength. As for the original moves, there was still huge reliance on imperfect Russian rail infrastructure and resources to move air formations around. On 15 July Collishaw was tasked to move B Flight to the theatre of operations around Kharkov, nearly 500 miles northwest. Five days later he was tasked to bring them back so that they could replace C Flight at Beketovka. Renamed C Flight, Capt Frogley's B Flight carried out its first sortie on 23 July, target Tcherni Yar. Capt Davis and the original C Flight returned to Ekaterinodar. On 25 July, No 47 Sqn recorded its first air-to-air victory. Two aircraft, pilots Capt Elliot and Lt J R Hatchett, were bombing targets at Kamishin when they were attacked by a Red Air Force Nieuport fighter. Hatchett manoeuvred to give his observer, Lt H E Simmons MC (another squadron pilot, flying as back-seater for this trip), a good opportunity to use his gun. Fifty rounds sufficed to send the Nieuport down, and although they themselves did not see the aircraft crash, Elliot and his observer Lt Laidlaw confirmed a crash close to Kamishin.

30 July saw an operation that developed into a prototype for any later James Bond, Indiana Jones or – of course – Biggles adventure:

> 'Three machines, piloted by Captains Frogley, Anderson, and Elliot, with Lieutenants Greenslade, Mitchell and Laidlaw, as observers, carried out a bomb-raid on Tcherni Yar. The machines came under heavy machine-gun fire from the ground. Captain Anderson and Lieutenant Mitchell were attempting to take photographs of the bombing, and Captain Elliot and Lieutenant Laidlaw were acting as escort. Captain Anderson's machine was shot through the starboard main tank and he turned for home when he suddenly saw Captain Elliot's



Representative of the opposition – a Bolshevik Nieuport.

machine going down, obviously in difficulties. He therefore followed Elliot down, and landed about a quarter of a mile away. Meantime Elliot set fire to his machine and Laidlaw used his machine gun against the Bolshevik cavalry who were approaching towards the British machines. Elliot and Laidlaw were, however, picked up by Anderson. Lieutenant Mitchell came home – a distance of 110 miles – standing on the lower plane, with his thumb blocking the hole in the petrol tank. The machine got off the field just as the Red Cavalry arrived. Captain Elliot and his observer were thus saved from the hands of the very troops on whom the attack was made. They had been shot down at 1,500 feet by fire from the ground, but, although Captain Anderson's aeroplane was also crippled, he went down to Elliot's help without hesitation.'[13]

This particular exploit resulted in Elliot receiving a Bar to his DFC. As recorded in the supplement to the *London Gazette* of 1 April 1920:

Flying Officer William Elliot DFC, 47th Sqn (RASC)

On the 30th July, 1919, whilst on special duty for the Russian Volunteer Army, Flying Officer Elliot was shot down

> about five miles behind the enemy lines. He then burnt the crashed machine, and kept off the enemy cavalry by machine-gun fire until rescued by another machine which flew to his aid.
>
> This gallant and highly skilful pilot has carried out forty-five long-distance raids over the enemy lines during a period of four months, and has been continuously on active service since August, 1917, during which period he has taken part in ninety-five raids, and brought down six enemy machines.[14]

Not unreasonably, Anderson and Mitchell (listed in that same supplement, respectively, as 'Flight Lieutenant and Observer Officer, 'C' Flight, 47th Squadron.') were awarded DSOs. That citation bears examination for one detail, where it states:

> 'The risk involved in attempting this gallant rescue was very great, as had any accident occurred in landing the fate of all four officers can only be conjectured.'

Ira Jones, in his *Air Fighter's Scrapbook*, affirmed that the Bolshevik authorities had singled out aviators for special treatment if captured: crucifixion as a minimum, and with a fifth nail through the most tender part of the anatomy for added value. No doubt Anderson was honoured and pleased to receive special mention in a despatch by General Baron Wrangel, GOC the Caucasian Army, plus the award of the St George's Cross (3rd Class), but far happier to have avoided the Bolsheviks special award.

July's end and August's beginning saw no reduction in the squadron's efforts. Gen Wrangel's focus was on the river traffic coming up the Volga from Astrakhan, and the squadron flew regular missions against main concentrations and logistic transfer points at Tcherni Yar and Staritska. The Bolshevik/Red Air Force had an airfield at Tcherni Yar and occasional air-to-air combat was part of the operational work for the squadron. Lts Hatchett and Simmons (previously mentioned) were thus engaged on 25 August, but with a gun jamming they had to break off inconclusively. Five days earlier, another Red Nieuport attacked the DH 9 of Lt Cronin, whose observer (Lt Mercer) brought down the attacker after four exchanges of fire at between 50 and 100 yards range. These four were also to be awarded DFCs for their operational successes. By the time the deployment

Flt Lt S M Kinkead at Beketovka with one of No 47 Sqn's Camels wearing the markings of the White Russian forces.

ended, No 47 Sqn's aircrew had been awarded four DSOs, one bar to a DFC, and ten DFCs. One of the DSOs was to Flt Lt S M Kinkead DSC.

This draws out the changing nature of the squadron's role and equipment. While much was going on in the air, back at the Ekaterinodar HQ squadron commander Collishaw was keeping the pressure on to maintain a flow of serviceable aircraft at the front. During August, twenty-one machines were either assembled or overhauled for service. Some DH 9s were shipped in to Novorossiisk (on board *Ark Royal*). They had been sent by rail from Baku (after Caspian Sea service with No 221 Sqn - see below) to Batum for onward shipment. But in the following month a batch of Sopwith Camels arrived, shipped across from their Aegean base of Mudros. They were not in good shape but four were made fully serviceable, and were to form the basis of Kinkead's B Flight. Kinkead, South African born, had been a highly successful RNAS pilot, and would serve again with Collishaw in the early 1920s. He was killed during the work-up for the 1928 Schneider Trophy race. His story has recently been written by Julian Lewis MP.[15]

First blood to the Camels was on 30 September, when Kinkead – escorting a DH 9 reconnaissance sortie over Tcherni-Yar. Two Red

Nieuports came up and Kinkead shot one down, into the Volga. The squadron was using a forward base at Kotluban, northwest of Tsaritsin, giving the B Flight Camels, with their shorter range than the DH 9s, the chance to get among the Red rear echelons as they moved towards the city. From there Collishaw had a pair of air-to-air successes as well as joining in a series of strafing attacks against a major Red cavalry attack, inflicting huge casualties – one 'body count' suggested 1,600 dead. But he then fell sick, was diagnosed with typhus and evacuated by hospital train, initially back to Tsaritsin, then intended to make for Ekaterinodar. But when the train stopped at a village along the line, he was in such poor shape that he was taken off and – according to one piece of the unofficial record – looked after by an elderly Russian lady, then placed into a Russian hospital. It seems the British authorities rather lost touch with where he was!

The hectic pace of operations, and the inevitable spread of news of the squadron's activities, now caused a change in public policy for the RAF's operations. Jones' book (*Over the Balkans*) logs the output for September: 135 hours and 20 minutes of operational sorties; 11,622 lbs of bombs dropped; 8,150 rounds of machine gun ammunition. October's numbers were considerably more: 228 hours and 50 minutes; 37,206 lbs; and 14,000 rounds. But the recently-arrived Head of Mission (Maj Gen Holman, replacing Lt Gen Briggs), on one of his many visits to the Kotluban base, gave them the news that the squadron was effectively to disband and be merged with the training mission. Only volunteers would remain (and virtually 100% offered their services) and their operations would be reported as being by A Detachment of the Training Mission, now under operational command of Maj J O Archer. And the operations were more intense than before, regardless of the title of the unit. Typical of the period are these two DFC citations from the *London Gazette*:

> Observer Officer Roger Addison MC, 'A' Detachment (9th E Lanes R).
> Displayed conspicuous ability on 10th October, 1919, at Tsaritzin, when about forty vessels, armed with all kinds of guns, broke through the Volga defences north of the town. He descended on three occasions on that day to very low altitudes, and, dropping his bombs with precision, inflicted heavy

casualties on the enemy, although subjected to very fierce fire from them.

Flying Officer Arthur Hilton Day, 'A' Detachment (3rd Cheshire Regt).
At Tsaritzin, on 10th October, 1919, when the large flotilla of Bolshevik vessels broke through the Volga defences, he descended to a low altitude, and, by means of bombs and machine-gun fire, materially assisted in the complete rout of the enemy ships which subsequently followed. He has proved a gallant officer in every situation, and was wounded on the occasion above referred to.

Once again, we see the cross-over of aircrew roles – Addison, the 'observer officer', was in the front seat for this flight (and others on the record). A few days later, the Reds managed to re-assemble a small fleet of armoured and gunned barges and other shipping, with the aim of bombarding Tsaritsin. Flying Officer Frogley led a gaggle of DH 9s into an attack, and got a DSO for his leadership:

Flying Officer Sydney Gilbert Frogley DFC, 'A' Detachment (3/R Berks).
A fleet of about forty Bolshevik vessels, armed with all descriptions of guns, having broken through the defences of the Volunteer Army, commenced a bombardment of Tzaritzin *(sic)*. Flying Officer Frogley led a formation of machines on 15th October, 1919, and at a height of 1,000 feet dropped his bombs with such effect that the fleet was dispersed, several vessels having been destroyed. During a period of four months, this officer has rendered invaluable services in South Russia.[16]

On 17 October Capts Kinkaid, Burns-Thomson and Daly bombed an artillery battery, putting it out of action. This trio maintained a steady rate, flying their Camels each day until 24 October, invariably against army targets, while the DH 9s of the other flights maintained their pressure on river traffic. Thus Capt J W B Grigson and his observer, Lt E G T Chubb, had three days of attack missions against Volga vessels.[17] Steady success was marred on 24 October by the death of Capt Keymer and his observer Lt Thompson. Their bombs fused early and exploded as they took off, killing them instantly. And

to add to the complications of front-line operations, both Col Maund (who was about to be advanced to acting brigadier[18]) and General Holman were visiting, and over the next three days would insist on being taken up on standard bombing missions, attacking river traffic north of Tsaritsin and Dubovka.

But by now, Denikin and Wrangel were stretching beyond their supply lines, especially in the push towards Moscow, and from the beginning of November, the Red forces were able to reclaim their lost ground. In the increasingly poor weather, and in the uncertain tactical position across the various fronts, the activities of 47 Squadron lost momentum. But the variety of their actions, and the challenges of maintaining their entire operation with the use of railway traffic – trains to live in, sleep in, feed in, carry the aircraft from landing strip to landing strip; trains, towards the end, to have extra carriages and wagons hooked on to carry the refugees fleeing from the unpleasantness that the Bolsheviks were promising – gave all those involved a unique set of experiences. The meanderings of the various support trains and their personnel ranged across all the Donetsk – Mariupol – Rostov region, recently ravaged by the Russia-Ukraine conflict. Collishaw, returned from sickness, resumed command during this chaotic phase, and was himself active up to the last days of operation at the end of March 1920. Those final four months – until the evacuation of the entire British Mission structure with its close on 2,000 personnel at HQ and the various training and operational units – require book-length treatment[19].

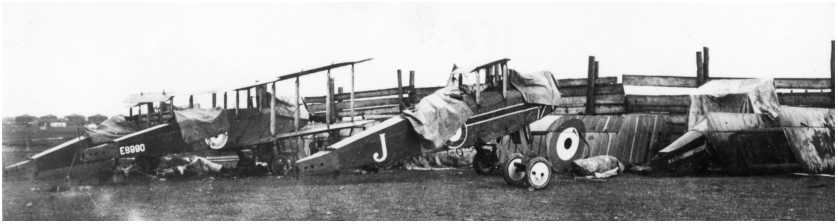
Since that space is not available here, it remains only to note that the Red Air Force had been forced to move aircraft from the Astrakhan area to cope with White and British attacks against their concentrations around Tsaritsin. They could afford to do that, since they were no longer under pressure from the British air squadrons at their Caspian Sea bases. Which ones were these?

They were Nos 221 and 266 Sqns. No 221 Sqnwas a DH 9/DH 9A unit, formed on 1 April 1918 from D Squadron of No 2 Wing, RNAS, initially at Stavros in Salonika, moving later to Mudros, across the Aegean.[20] No 266 Sqn had Short seaplanes, and also started as a gathering of RNAS Flights at Mudros, on 27 September 1918. The two squadrons' whole sequence can be best followed in the narrative already cited (*Gone to Russia to Fight*[7]) but there are some remarkable

diaries and logbooks within the RAF Museum collection, from which I shall draw some extracts to give the flavour of war in the Caspian.

Since it is the most complete, I shall open with items from the logbook of John Archer Sadler.[21] His adventure begins on 16 August 1918 when he is appointed OC RAF Contingent HMS *Empress*, before going on leave until 16 September. The ship and accompanying convoy left Plymouth on 26 September, and with port calls in Gibraltar and Malta arrived in Mudros outer harbour on 12 October. DH 9 and Camel airframes were discharged to Lemnos. The next month is spent on air testing the various seaplanes; for example he was airborne on 1 November in a Short 184 seaplane with 260hp (Sunbeam) engine, serial 2813. On 10 November *Empress* leaves Mudros and, as the first large ship though the Dardanelles for some time, makes safe passage to San Stephano Bay, on the western edge of Constantinople. More reconnaissance and inspection of possible seaplane bases precede an early-December return to Mudros. On 3 January 1919, he is '. . . confirmed in the rank of Captain RAF.' And at the end of the month he '. . . took over command of Talikna Air Station from Capt Wright.' This was the seaplane base on Mudros, and on 1 February he '. . . handed over command of Talikna seaplane squadron (266 Sqn RAF) to Maj E Beauman.' In the full richness of orders of the day, his log book now records that on the same 1 February he '. . . took over command of 437 Flight Russian Draft (changed into 266 Squadron 62 Wing).' And with the first part of that draft he set sail from Mudros on HMS *Engadine* (like other seaplane tenders/'aircraft carriers' of the day, a converted South Eastern & Chatham Railway cross-channel steam packet), leaving on 18 February and arriving a week later in Batum. A little re-organisation then took up the next ten days, but with time available for the Ball at the Russian Club – no further details provided. With men and machines appropriately loaded, the draft left Batum by train on 6 March, passed through Tiflis overnight 7/8 March, through Baku 72 hours later, and on the morning of 12 March finally arrived, some 200 miles north-west of Baku up the Caspian coast, at the small port of Petrovsk (now Makhachkala – capital of the Dagestan Republic, with nearly 600,000 population.)

No 221 Sqn had been quicker on the draw, and were already there at Petrovsk, and had already seen action. Their progress followed

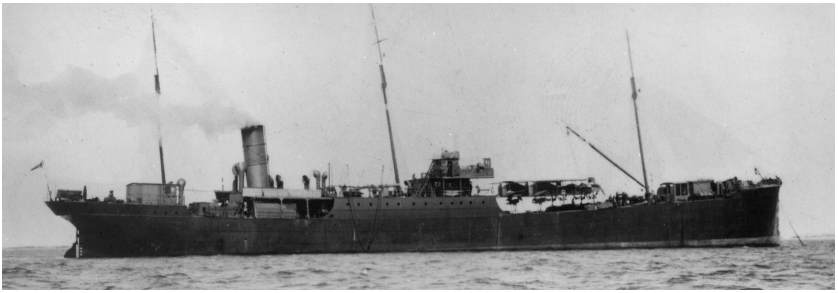


No 221 Sqn's DH 9s being erected at Petrovsk in January 1919. (RAF Museum P12291)

much the same route and pace as that of No 266 Sqn, but – under command of Maj John Oliver Andrews[22] – they had left Mudros on another seaplane tender, HMS *Riviera*, on 30 December 1918. With a short stop in Constantinople, the party arrived in Batum on 3 January, where the offload and reload on to train was completed without major incident. Arrival in Baku on 9 January and at Petrovsk on 12 January, where the train was pulled up on to a siding at the edge of the airfield. Aircraft erection was started immediately, but also the building of screens to protect against snow; there were no hangars. First problem was the difficulty with the liquid-cooled engines of the DH 9s – starting was a perpetual problem. Maj Andrews had his personal Camel, and its air-cooled Bentley engine gave no problems.

The main task of these squadrons was to be the support of British vessels of the Caspian Flotilla, and thus denial of operations to the Red fleet based principally in Astrakhan, but also operating out of an Eastern Caspian port, Fort Alexandrovsk (now Fort Shevchenko, a base for the Kazakhstan Navy). The British Flotilla had started operation during the Dunsterforce operations mentioned earlier. Still under Cdre Norris, the flagship was the HMS *Kruger* (previously SS *President Kruger*, a coastal freighter with some passenger accommodation), with some nine or ten other vessels overall. To add to his command, Norris had asked for a dozen Coastal Motor Boats (CMBs) to be sent up by train from Baku, and these carried a single torpedo each plus twin machine guns. Finally another freighter, the SS *Aladar Youssanoff*, was converted into a seaplane carrier, for use by No 266 Sqn.

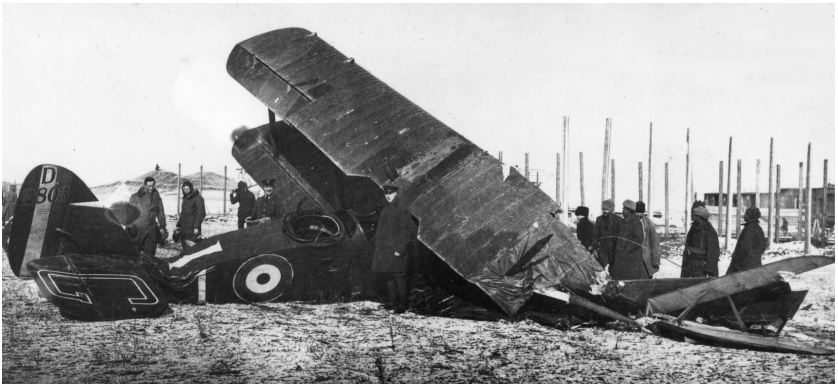
The commander of 62 Wing was also on the move, leaving Lemnos for Batum in early February 1919, aboard another converted



The SS Aladar Youssanoff *with a pair of No 266 Sqn's Short 184s (wings folded) on deck between the bridge and the forward mast. (RAF Museum P1341)*

railway company steamer, the London and South Western Railway's former *Princess Ena* . This was Maj (Temp Lt-Col) Frederick William Bowhill.[23] Bag carrier, and tasked with the setting up of the seaplane base, was a Lt C N H Bilney, whose unpublished memoir (quoted in Smith's *Gone to Russia to Fight*) describes his boss as '. . . a shortish red-faced man with bushy ginger eyebrows, outwardly a little brusque but with a heart of gold and a great gift of leadership.' Their progress across the Caucasus was slow, leaving Batum eventually with four of the CMBs as part of the train's cargo, and after time in Baku, arriving in Petrovsk on 1 March.

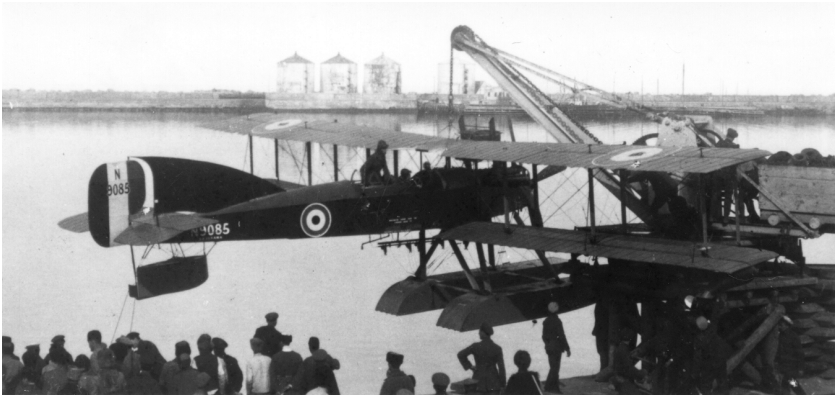
By this time No 221 Sqn had been in action, with some effective sorties flown in the first week of February. Targets were Red ground force concentrations and railway logistic areas. Bombs were dropped on Kizlyar, 120 miles northwest of Petrovsk, and later in the week the focus was on Grozny (target for the Germans in 1942, and more recently under assault in the Russia – Chechnya conflict of the 1990s), as the White forces advanced on the town. Further still in range demands were attacks the same day on Naurskaya, north west of Grozny, a major road/rail/river confluence, important for the Reds' logistics. Rail track was destroyed and trains derailed. But this was not without loss and two aircraft were lost to ground fire during these low level attacks. Fortunately both crews were able to evade capture and return to base. It was clear, however, that the aircraft at Petrovsk had insufficient range to attack Astrakhan. So Maj Andrews used his Camel to carry out some reconnaissance, looking for advanced



One of No 221 Sqn's original batch of DH 9s shipped in from Mudros in 1919; D2803 did not last long, being written off by Capt J W B Grigson and Lt O R Gayford on 3 February. (RAF Museum P12286)

landing strips, while one of the squadron DH 9s had a look at Chechen Island, which was off the coast some 100 miles north of Petrovsk, and could – if useable – take about a third off the range requirement. In the event these efforts were inconclusive, mainly as a result of poor weather impeding any decent view of terrain.

But Capt Sadler and his draft arrived on 12 March, by which time the officer Bilney had sorted out some accommodation and shelters for the aircraft. He had also had installed a dockside crane for lifting the seaplanes in and out of the harbour. No 221 Sqn's DH 9s do some desultory 'showing the flag' flying, but there is little effective coordination with the White command structure and therefore little or no coherent targeting. A further Chechen Island reconnaissance was carried out and the result – although noting that the island was iced up, making sea re-supply tricky for the time being – was that the landing area looked to be useable. Thus March came to an end, and the only really positive element was that Cdre Norris had disarmed the so-called Centro-Caspian Flotilla, a group of small armed vessels operating out of Baku. He had employed those newly-arrived CMBs with their torpedoes, and then took over three of the remaining Red vessels to add to his own holdings. These were re-named HMS *Windsor Castle*, *Dublin Castle*, and *Orlionoch*, the latter being later in use as a replacement seaplane carrier in place of the *Aladar*



March 1919 – Capt J A Sadler and Short 184 N9085 of No 226 Sqn being hoisted out for the first time at Petrovsk. (RAF Museum P1337)

Youssanoff.

April 1919, and Capt Sadler's logbook now shows regular test flying of his charges, showing them for example as 'Short Maori' serials [N] 9078, 9082, 9085. Maori (sometimes logged as Maori III) is reference to the Sunbeam 260 hp Maori engine. On 25 April, the first flight of N9081 got off to a bad start. The photo is from his wonderful photograph album, held at the RAF Museum.[24] Sadler and Bilney had to make many improvisations to ensure the squadron's operation from on shore. A manuscript note in the Archer photo album, showing him and his aircraft N9085 being hoisted off the dock and into the water, states that 'In order to get our machines in the water at the shore base at Petrovsk, in Daghestan, we had to build up the rails on which the crane ran on sleepers, so as to get the necessary overhang.' Nobody said it would be easy!

It certainly wasn't for Maj Andrews, who contracted typhus while on a ground reconnaissance north of Petrovsk. He was invalided home. But his squadron continued to attempt operations as April arrived. Planned use of Chechen Island as a re-fuelling and re-arming base was frustrated by bad weather on 6, 7 and 8 April. Another attempt on 14 April was again only partially successful, since although the fuelling and arming was completed at Chechen Island, bad weather forced the four DH 9s to turn back when still some distance from Astrakhan. Success was finally achieved on 21 April, as the ice began

to clear from the Volga delta, and Red ships began to venture forth into the Caspian. 221 Squadron's DH 9s found several 'targets of opportunity', and returned safely. Flight durations were in excess of four hours, and total distances covered were up to 360 miles, with over three quarters of that over sea – no mean feat given the virtually total absence of any quick reaction search and rescue craft. But on a later sortie, one aircraft was lost to engine failure, over land, and another squadron aircraft went out and dropped rations to the crew, who made a successful 50-mile walk back to base.

Early May saw no real improvement in weather, but brought strong rumour that Red contingents were approaching Petrovsk and attacks could be expected. Sadler's logbook, for 4 May, records: '"Action Stations". Evacuate billets 0430. Rumour of 3000 Tartars.' False alarm, maybe, and an airborne reconnaissance showed no sign of the rumoured force. However, a British soldier was killed by a grenade the next day in the port complex. Sadler had another shake-down flight of one of the Maori-engined seaplanes (N9080) on 06 May and a week later the carrier *Aladar Youssanoff* set off for Chechen Island. They arrived in the evening and the following morning Sadler, and the *Youssanoff's* skipper, Lt Chilton DSC RNR, went on board the flagship *Kruger* for a tactics talk with the Commodore. The result was a foray involving six of the Flotilla's vessels: flagship plus the seaplane carrier, together with the CMB-carriers *Edinburgh Castle* and *Sergie* and the armed merchantmen *Asia* and *Emile Nobel*. They were to rendezvous near Kulali Island, north of Fort Alexandrovsk, for what Sadler noted in his logbook was to be the 'Alexandrovsk stunt'. On 15 May Sadler notes being on watch from 0200 to 0400, with first sight of the enemy at 0520. Frustratingly the weather was too rough to launch either CMBs or seaplanes. But the appearance of the British force made the Reds turn tail and head away northwards, leaving behind a couple of barges loaded with fuel. Sadler's logbook reads: 'One barge was set on fire by first shot of *Emile Nobel* and other was hit 4 times below water line by *Kruger* and sank gradually. Crews of both barges were taken off before sinking same.' The naval report has some more detail, which it is difficult not to include for its entertainment value.

'The second barge, which was flying a flag of truce, was dealt

> with by the *Kruger*. The *Asia* took up a position ahead and pumped out oil, as there was a sea running, and the *Kruger* anchored as near as possible and took off the crew, preparatory to sinking the barge. At the last trip the first-lieutenant (Pitcairn-Jones) was told to haul down the flag of truce, which proved not to be a flag at all, but a pair of under-garments belonging to an old lady of 60 who was one of the crew of the barge.'[25]

So much for the seaplane pilots' excitement. The landplanes were still actively trying to overcome the weather, with modest success. Four DH 9s left Chechen Island on 10 May and found shipping targets in the main channels through the Astrakhan delta: at Mogilny, barge traffic was hit as well as the seaplane station; store sheds were set on fire at Harbay. On 14 May, a first attack was carried out by a newly-arrived DH 9A, operating from Petrovsk. Six 9As had been shipped to Batum, on *Ark Royal*, in early April, and then carried across by rail. With its increased wing area, and more reliable and considerably more powerful engine, there was now a chance for more flexibility and capacity in both range and bomb-load. On this sortie an armed tug and barge were bombed and driven ashore. But on 15 May, four DH 9s left Petrovsk for Chechen Island. One crashed and burned on landing, killing the crew, Lts B E Nelson-Turner and G E Jemmeson. This gets a mention in another diary of one of these men far from home in a strange war: air mechanic Miles Henry Cox, of 221 Squadron.[26] His entries are laconic and economical. I must quote one or two, with his having arrived in Petrovsk on 20 January:

> 23 Jan – Cold, wet, windy. News received that England had declared war on the Bolsheviks. Nothing special doing. (That latter phrase soon becomes simply 'NSD' in later entries).
> 03 Feb – 2 machines crashed on drome and another one with Lts Macdougall and Loughborough missing.
> 04 Feb – Now reported machine missing yesterday crashed near Grosni *(sic).* Plt and obs safe.
> 05 Feb – Lts Leaman and Dingle crashed on drome. Lts Parry and Bartlett missing. Now safe.
> 09 Feb – slight mutiny of troops.
> 30 Mar – had first dip in Caspian.

And so:

> 14 May –DH 9A bombed tug and sank it near Harbay.
> 15 May –High SE wind. 4 machines left for Chechen. 1 crashed and pilot Lt Turner and obs Lt Jemmeson burned to death at Chechen.
> 21 May –buzz about going home.
> 22 May –Lovely day. Action off Alexandrovsk. 8 killed on Emile Nobel. 7 enemy ships sunk.

That was how it seemed to the fellows on 221 squadron. But for No 266 Sqn it had been a day of extreme exertion, as part of a combined operation to neutralise the Red Caspian operations. After the sinking of the barges on 15 May, there were a couple of handling accidents to the *Youssanoff's* seaplanes and she sailed back to Petrovsk to get replacements or repairs. Back with the flotilla, on 20 May Lts Thompson and Bicknell bombed the port at Alexandrovsk. To keep the maintainers busy, Lts Morrison and Pratt crashed 9079, 'making a climbing turn at 200 feet with a dud engine.' Sadler notes that he aborted a sortie on 20 May (in 9080) because of water in the petrol, jettisoning bombs on the return flight. Next day, same again, taking off at 0415 but back alongside by 0445. As he remarked: 'Beautiful day for flying. Very bad luck.' But that afternoon it all started to come together, and at 1515 he took off with Lt Kingham as observer and found the Caspian flotilla bombarding the port facilities and shipping at Alexandrovsk. He attacked the guard ship at the harbour entrance, and machine gunned other ships and buildings. Then came 22 May, and with what seems to have been the only serviceable aircraft (9080) the squadron spent the day attacking Alexandrovsk. Sadler's logbook notes that he was mentioned in despatches, as is confirmed in the following extract from Rear-Admiral, Black Sea's Despatch on Caspian Sea Operations:[27]

> 'The following despatch has been received from the Rear-Admiral, Black Sea, on the action in the Caspian Sea off Fort Alexandrovsk, on the 21st May, 1919:
>
> [. . .] I have the honour to call particular attention to the services rendered by the following officers of the Royal Air Force who between them carried out 5 raids in one seaplane on

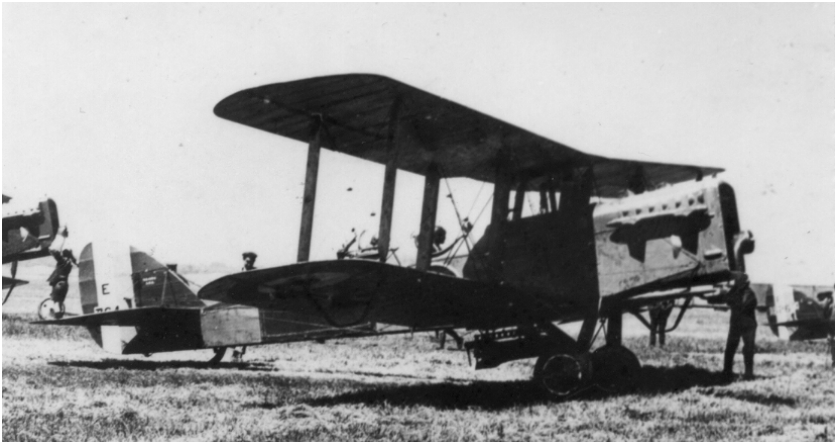
> the same day with excellent results, and attempted a sixth, and also the services of Lieutenant Chilton, RNR, commanding 'A Yousanoff', for his able handling of the ship and organisation which allowed this to be done.
>
> Pilots
> 2nd Lieutenant Howard Grant Thompson
> Captain John Archer Sadler
> 2nd Lieutenant Robert George Kear Morrison
>
> Observers
> Lieutenant Frank Russell Bicknell
> 2nd Lieutenant Frank Leslie Kingham
> 2nd Lieutenant Henry Godwin Pratt'

23 May was to be the last day of 9080's war. Early that morning, two Red destroyers had been in gunfire engagement with the Caspian flotilla, and the seaplane was launched to join in, but fog set in and the seaplane was put down, having signalled its position to *Youssanoff*. Sadler taxied the machine for over two and a half hours until one of the fuel tanks ran out, early afternoon. While still on the move on the other tank, the sea swell and the weight imbalance dropped the tail into the water and elevator and rudder were torn off. The machine then turned over, with Sadler and observer Kingham hanging on to the floats. They were eventually spotted by HMS *Asia*, still clinging to the one remaining float, and picked up in the evening of 24 May, after over 24 hours in the water. Sadler returned to Petrovsk and with Alexandrovsk effectively emptied of Red warships, the focus was more on Astrakhan and the Volga delta, to which the survivors had retreated. Thus more work for the DH 9s and 9As of No 221 Sqn.

Cox's diary records raids on targets 'in the mouth of the Volga' on 26 and 31 May. On 06 June he again records a:

> 'Lovely day. Left Petrovsk for Chechen on DH 9A at 3.00 pm, arrived 4.10. Pilot Capt Keymer.[28] Lovely flight. Course along Uch Peninsula. Chechen small sandy island about 12 sq miles, off Uch Pen. Village on island. Houses built of wood. Rendezvous for Caspian fleet behind Chechen.'

He was to remain on Chechen until 4 August. 'Google Earth' will confirm that it is indeed a small sandy island – and today there appears



One of the DH 9As ,E764, operated by No 221 Sqn.
(RAF Museum P12305)

to be nothing but sand. Raids against Astrakhan area targets were carried out from the Island and from Petrovsk during the rest of June. On 16 June, Lts Mantle and Ingram were forced down, damaged by a Red Nieuport. They set fire to the machine and attempted to evade, but were taken by Red cavalry and sent to Moscow as prisoners of war. They were repatriated in April 1920. One flight was detached and deployed north to Lagan, on the coast about halfway between Chechen Island and Astrakhan. As well as for bombing sorties, these aircraft were used as messengers between advancing White columns as they approached Astrakhan, landing alongside troop columns and transferring sitreps.

Seaplanes of No 266 Sqn maintained desultory bombing and reconnaissance missions, with occasional incidents. Capt Sadler had been off sick with malaria for much of the month, but was back in command in time to launch Lts Thompson and Bicknell in 9082 on 28 June. They found the swell too much and dropped one of their 112lb bombs to lighten the aircraft and give it a better chance of getting airborne. Unfortunately the bomb exploded (‘Obs – just check the jettison safe switch!’) and blew the aircraft in half. The two survived with light injuries. Machine a write-off.

July saw No 221 Sqn continuing missions in direct support of the

battles around Astrakhan. Meanwhile, No 266 Sqn had a change of style when the *Youssanoff* was sent back to port for a major boiler overhaul – it had been steadily losing pressure and under-way speed was falling to a useless near-zero. The CMB depot ship *Orlionoch* was brought in as replacement and returned to the normal operating area on 17 July, with two seaplanes aboard. Capt Sadler and Lt McCughey took those two airborne on 18 July but got lost in the mist on return from a bombing sortie along the coast near Lagan. They beached the aircraft and spent the night in a fisherman's cottage, returning to the carrier the next day. On 24 July an armed reconnaissance sortie was airborne and had engaged enemy shipping with bombs and gun attacks. Return fire hit Sadler's aircraft and he was forced to put down about 15 miles off the coast, being eventually towed back to the *Orlionoch* by a CMB.

By now, Col Bowhill was under orders to withdraw 62 Wing by the end of August, mainly as a result of malaria and other fevers afflicting many of his men. But while missions continued for both squadrons, the pace was slackening although incidents continued to focus the participants; minds. Lt Lynch had to abandon his DH 9A on 10 August, force-landing it southwest of Chechen Island on his return flight to Petrovsk. He and his observer made their way home safely, with food dropped by another squadron aircraft the next day. No 221 Sqn's last raid was on 12 August and the run-down now moved quickly. DH 9s were handed over to White air force elements, but the serviceable DH 9As were dismantled and moved by train and ship via Baku, Batum, and Novorossiisk to then go forward to join 47 Squadron, together with a number of pilots who had volunteered to continue in Russia. No 266 Sqn's assets were similarly dispersed, along with the O*rlionoch* and the rest of the Caspian flotilla vessels, all handed over to the Whites by 28 August.

Sadler's diary had noted, on 18 August, that 'Colonel Bowhill, 221 Squadron, and 266 Squadron except self, Spalton, and 5 men, left for Constantinople via Grozny and Ekaterinodar.' Bowhill's erstwhile bag-carrier, Capt Bilney, described an effusive Russian send-off, noting the '. . . sight of our beloved Wing Commander being embraced and kissed on both cheeks by the local Russian general. Ginger Bowhill was the last man in the world to enjoy anything of this sort.'

A slightly scary image of Air Chf Mshl Sir Frederick Bowhill who, as a Major (Temp Lt Col) and later a Wing Commander, was OC 62 Wg in the Aegean and then South Russia in 1918-19. (Air Historical Branch)

Bowhill's carefully handwritten note book containing what are presumably drafts of all the reports he wrote on finishing his command, plus copies of all the interchanges between himself and the various White Russian commanders, makes vigorous plea for recognition for his men. I quote from the last paragraph of his report to Senior Naval Officer Caspian, dated 23 July 1919:

> 'I submit that when any recommendation for awards, which I may put forward are being dealt with, full consideration may be given to my remarks above on the work of the Royal Air Force units operating in the Caspian area, as I feel strongly that such awards will be fully deserved. Further I would have it taken into consideration that these men were having a very rough time on active service under arduous conditions. I would also point out that with the exception of six men, none were volunteers and a large proportion of them were eligible for demobilisation from the very beginning, but had to be compulsorily retained.'[29]

There were indeed a number of awards, some of which have already been cited. Russian decorations proliferated even more vigorously. Ira Jones was positively dismissive:

> 'Medals are apparently two a penny in this war. Fellows get a Distinguished Flying Cross for shows which were considered as 'all in the day's work' in France. As for Russian decorations – they are bought in the shops.'

He is no doubt entitled to his view. For the men of these squadrons, the more important feature of life was to be a safe and expeditious return home. Air Mechanic Cox (who had entered RNAS service on 19 June 1917) left Petrovsk on a Russian steamer on 15 August 1919, in the company of a bunch of soldiers from the 84th Punjabis. From Baku, the train journey followed the standard route through Tiflis to

Batum, and the next ship was the SS *Magdalena*, out of Batum on 23 August. Time for some R&R with others from 221 Squadron in Constantinople, before boarding HMT *Rose* and departing on 2 September. With stopovers in Salonika and Malta he arrived in Marseilles on 12 September, thence by train through Lyon, Paris, and Amiens to get to Boulogne on 14 September. Across to Folkestone the next evening, and various transport foul-ups enlivened the rest of the journey before arrival at Halton on 16 September. His diary is a perfect embodiment of the 'administrivia' of finishing an operation:[30]

> 19 Sep: saw demob officer; nothing doing; 20 Sep: on guard; 21 Sep: NSD;
> 22 Sep: paid; 23 Sep: NSD; 24 Sep: filling in paper; 25 Sep: DEMOBBED. Left Halton camp 4.0 pm; 22 Oct: discharged from today; 23 Oct: transferred to RAF Reserve on this date.

Job done. For Capt Sadler much the same progression. Leaving Petrovsk by train on 27 August, he arrived in Novorossiisk on 29 August and went aboard HMS *Grafton* but before departure on 31 August moved on to the *Princess Ena*. Via Crimean ports of call they reached Constantinople on 4 September, and via Taranto and Naples got to Folkestone on 16 October. In his case to continue a career that lasted until retirement as a group captain on 1 January 1942. It included deck landing trials off Malta in 1924, using HMS *Argus*, which was the carrier that took 151 Wing's Hurricanes to Russia in 1941. More of that *déjà vu* about to happen?

Howsoever, his story, and Cox's, and all the other airmen's, have combined to capture a short and often violent segment of Royal Air Force operational endeavour, undertaken as the Service came into existence. Undoubtedly *per ardua ad astra*.

Notes:

1 See 'The Royal Air Force in North Russia' by Air Cdre Phil Wilknison in *RAF Historical Society Journal 36*, pp92-105.

2 Dobson, Christopher & Miller, John; *The Day We Almost Bombed Moscow* (London; Hodder & Stoughton; 1986).

3 TNA CAB 23/8, cited in Kinvig, Clifford; *Churchill's Crusade* (London; Hambledon Continuum; 2006).

4 Maj Gen Lionel Charles Dunsterville (1865-1946) was commissioned in 1884 and

had served in India, Waziristan and China. At the outbreak of war he was posted to India. He was the character 'Stalky' in Rudyard Kipling's school boy tale, *Stalky & Co*. They had been at school together. After the war, Dunsterville wrote a book, *Stalky's Reminiscences* (London; Jonathan Cape; 1923) about his entire life, including the war.

[5] Dunsterville, L C; *The Adventures of Dunsterforce* (London; Edward Arnold; 1920).

[6] LG 31457. These citations were among those published on 15 July 1919 in the Eighth Supplement to the *London Gazette* of 11 July.

[7] Lt-Col Arthur Clinton Maund, later to be AVM A C Maund CB CBE DSO. Born London 30 July 1891, he was originally in the Canadian infantry before transfer to the RFC in 1916. He had been with the British mission aiding the Russians in the north, and had been operational in BE2es. He later took command of the RAF air element in Archangel. His transfer to the south, to head the air echelon at British HQ at Ekaterinodar, reflected this considerable Russian experience. Post-war he held senior commands, including command of A&AEE, Martlesham Heath. At the time of his death, on 13 Dec 1942, he was AOA at HQ Technical Training Command.

[8] The full activities of the squadron are best followed in four references:
Jones, H A; *Over the Balkans and South Russia* (London; Edward Arnold; 1923)
Gunn, R; *Raymond Collishaw and the Black Flight* (Toronto; Dundurn; 2013)
Smith, John T; *Gone to Russia to Fight* (Stroud; Amberley; 2010)
Jackson, Robert; *At War with the Bolsheviks* (London; Tandem; 1974)
Further coverage is also, as already noted, in Dobson & Miller and Kinvig, *op cit.*

[9] TNA AIR1/2387/228/11/47. In the 1920s, it was a routine procedure for officers attending the RAF Staff College to submit an account of their wartime experiences; Sqn Ldr A C Maund was a student on No 3 Course, 6 May 1924-27 March 1925.

[10] Jones, Ira; *An Air Fighter's Scrapbook* (London; Nicolson & Watson; 1938).

[11] The enterprise is on record in Jones, H A *op cit* pp141-2.

[12] Jones, H A *op cit*, pp144-5.

[13] Jones, H A *op cit*, pp149-50.

[14] Elliot's survival set him on the path to high command. After inter-war years as, *inter alia* Flight Commander on No 14 Sqn, he rose to be AOCinC Fighter Command and eventually retired, in 1954, as Sir William Elliot GCVO KCB KBE DFC*.

[15] Lewis, Julian; *Racing Ace:Fights and Flights of 'Kink' Kinkead DSO DSC*DFC** (Barnsley; Pen & Sword; 2011).

[16] LG 31847. These three citations were among those published on 1 April 1920 in the Sixth Supplement to the *London Gazette* of 30 March.

[17] LG31974. Published on 12 July 1920, the Second Supplement to the *London Gazette* of 7 July, shows a DFC for Chubb and DSO for Grigson, already DFC and Bar (Fifth Supplement 22 December 1919). He – Grigson – would go on to gain a second bar, gazetted 28 October 1921, for 'Services in Mesopotamia'. Like Elliot, noted above at Note 13, and a sizeable number of these South Russia decorated officers, he went on to achieve air rank. As an air commodore, he was AOC Rhodesia Training Group, and was killed in a flying accident there in 1943.

[18] Maund – see also Note 7 – would eventually shake off these Army titles and, in

the Supplement to the *London Gazette* of 12 July 1920 (LG31974), among the many Mentions in Dispatches for South Russia operations, he is recorded as Squadron Leader (A/Wing Commander) Arthur Clinton Maund CBE DSO. The same Supplement also notes his appointment as CBE.

[19] As well as those already shown at Note 8, where the final months are covered in full detail, Collishaw wrote his own memoir: *Air Command* (London; William Kimber; 1970). An American pilot with the squadron, Lieutenant Marion Hughes Aten DFC (gazetted, with so many others, in the Supplement of 12 July 1920), wrote a moderately over-inflated record which – like Collishaw's – does not bear too close comparison with the Mission and Squadron War Diaries. But it is a good read: *Last Train Over Rostov Bridge* (London; Cassell; 1961).

[20] See Annex L of Jefford, C G; *RAF Squadrons* (Shrewsbury; Airlife Publishing; 2001).

[21] The cloth cover of the log book illustrates the, occasionally confusing, evolution of the rank structure within the early air services. Marked in pen we see first 'Flight Lieut RN'; that is crossed out and replaced by 'Captain RAF' and finally by 'Flt Lt RAF'. It is Archive Object B1968.

[22] Retired in 1945, from post of AOA Training Command, as AVM J O Andrews CB DSO MC*. He was a high-scoring fighter pilot over the Western Front.

[23] Retired in 1945, from post of AOCinC Transport Command, as ACM Sir Frederick Bowhill GBE KCB CMG DSO*. His 1945 portrait certainly emphasises those bushy ginger eyebrows – RAF Museum collection, on loan from Air Historical Branch, accession number FA00136.

[24] Archive Object X007-0221.

[25] The Caspian Flotilla's operations are recorded in detail in the Naval Society's journal *Naval Review*, Vol VIII, No2, Chap 13 pp218-240, dated May 1920.

[26] In the hands of the RAF Museum as Archive Object X004-6066/001 'Diary of Miles Henry Cox, 19 June 1917 – 05 February 1920'.

[27] LG 31590. RAdm M Seymour's Despatch of 5 July 1919 was published on 9 October 1919 as the Third Supplement to the *London Gazette* of 7 October.

[28] The unfortunate Capt Keymer was one of those who volunteered to stay on with A Detachment after No 221 Sqn was taken out of the line. As mentioned in the text already, he was killed on 24 October.

[29] Notebook of Frederick W Bowhill containing reports on 62 Wing in the Caucasus and Caspian Sea 1919. RAF Museum Archive Object B3820.

OVERSEAS GEE CHAINS 1945-46

by Walter Blanchard

Originally published in March 2011 in the Newsletter of the Defence Electronics History Society, *Transmissions Lines*, Vol 16, No 1.

The end of the war in Europe, VE-Day, occurred on 8 May 1945, but the war against Japan continued for some months longer until VJ-Day, 2 September. After VE-Day it was not obvious how much longer Japanese resistance would continue and preparations were made to continue the fight in the Far East. Since former British territories had been occupied and it was necessary to reassert the UK's regional interests, the UK offered its assistance to the US in prosecuting the war there. It was to take the form of a long-range bomber force of up to 1,000 aircraft ('Tiger Force') which would operate from bases in the Far East. Such a large force required a very well-organised air resupply route between the UK and their bases, and plans were made to establish such a facility. The lessons of poor navigation having been well learnt during the preceding years, it was decided to support this route by building a string of GEE chains along it covering the Near, Middle and Far East. This required a very considerable feat of organisation and installation and, although it was never completed, some chains were built and put on the air before it was cancelled. As far as this writer is aware, this story has never been documented and it is not mentioned in any of the official histories.

A few, mainly anecdotal, details are known. For instance, in his Presidential Address to the Royal Institute of Navigation on 25 October 1978, Sir Edward Fennessy,[1] who had been responsible for, *inter alia*, the installation of the wartime GEE chains, provided some information. Nearly twenty years later, in 1997, a short paper, 'The longest GEE chain of them all – UK to Rangoon', was presented to the Centre for the History of Defence Electronics (as it was then[2]) by Mr Ron Martin who described his personal experiences as an RAF technician establishing GEE in India. More recently, research at the National Archives uncovered a document, AIR 2/7313, which gives exact dates of completion and the operational histories of these chains. This short paper gathers these sources together.

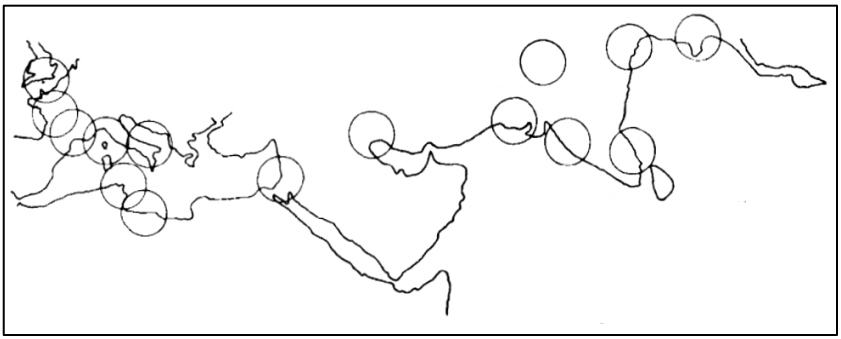
First, Sir Edward' address, in which he provided an excellent first-hand account of how GEE was implemented in Europe up to D-Day.

He then went on to describe the further extension of GEE to the Far East. In his own words:[3]

> 'I and my staff at 60 Group were to plan effective coverage for the route from the United Kingdom to Rangoon; in addition to the existing cover in the UK and on the Continent, fourteen new Chains were contemplated and an intensive programme of site selection and survey was put in hand, and proposals made and approved for a total system of chains extending from France, through the Middle East and India to Rangoon. The Carcassonne-Rhône Chain was rapidly sited and built; the Loire Chain followed and equipment was prepared for the whole project. However, before this ambitious plan came to completion, the dropping of the atomic bomb on Japan brought the war in the Far East to an end, and with it the operational need for such an extensive system. The end of hostilities in the Far East also brought about the cancellation of another project – to build a Gee Chain in Northern Luzon to provide navigational aid cover for Operation Tiger, a British bomber force to be based in that area. The proposed base was later moved to Miyako Jima, with the Gee stations in the Okinawa group of islands.'

Sir Edward died in November 2009 and, although it was hoped that perusal of his papers might provide further details, nothing further has come to light.

Ron Martin's paper provides more of the human angle than technical detail, but nevertheless fills in a few gaps. He says the type of radar used for these chains was the Type 100 which 'could operate either as Oboe or as GEE' but this was not so. The Type 100 could not be used as an Oboe station, but it could be used interchangeably for either plain hyperbolic GEE or the more accurate G-H ranging variant, and G-H is probably what he was thinking of. Each GEE chain comprised a Master and three Slave stations, four transmitter sites in all and, since dual-chain working had not then been developed, each chain operated as an independent entity. According to Martin, each Slave transmitter required staffing by 25 personnel, with the same number at the Master, augmented by a Chain Commander of squadron leader rank and additional administrative personnel, a total of some



Planned GEE Chain cover for air trooping to the Far east, 1945.

110 for each chain. There were to be 'several dozen' chains; Fennessy says fourteen, but whichever is correct it obviously required a major training and equipping programme for the (at least) 1,540 personnel involved. A special unit was set up at Haddenham airfield in Buckinghamshire to undertake, not only training, but assembly, tropicalisation and packing of all the necessary equipment. It was apparently very well done because Martin says that when they arrived in India, by sea, all the GEE equipment was 'in splendid condition', having been well packed, desiccated, sealed and wax-dipped.

He was flown out to Calcutta and eventually arrived at Barrackpore, the base for GEE support, in December 1945. By then, of course, the Japanese had capitulated and, somewhat to his disappointment, he was told that installation of his GEE chains was to go ahead regardless, in order to provide support for an anticipated air route for the repatriation of British troops and POWs. In January 1946, he was transferred to Delhi to assist with setting up a GEE chain which had its Master station some 50 miles to the southwest, then he returned to his base at Barrackpore. Subsequently he set up a Master station at the airfield at Chakulia, not far from Bihar, and describes how communication was established with the other chain stations by means of transmitting Morse code using the GEE frequencies. Shortly afterwards he was demobilised and returned to the UK.

AIR 2/7313 contains a complete list of all overseas GEE chains, their dates of completion and duration of operational activity. There are also some notes on how long each chain took from conception to completion – quite startlingly short intervals compared to what would

Chain Name	Date Proposed	Siting Completed	Surveying completed	Charts available	Operational	Total time taken
Adriatic					25/5/44 (changed to Bari 5/9/45)	
Rheims	10/08/44	11/09/44	21/09/44	03/10/44	04/10/44	7.5 wks
Ruhr	10/08/44	22/09/44	01/10/44	18/10/44	23/10/44 to 3/4/45 then changed to Kassel.	9 wks
Cologne	01/10/44	10/11/44	02/12/44	22/12/44	24/12/44 to 28/1/45	11 wks
Saar	01/11/44	13/12/44	23/12/44	20/01/45	11/1/45 to 3/4/45	11 wks
Metz	08/01/45	18/02/45	28/02/45	20/03/45	21/3/45 to 6/5/45	10 wks.
Munster	08/01/45	08/02/45	17/02/45	15/03/45	19/3/45 to 16/7/45 then changed to Nuremburg.	9 wks
Kassel	15/02/45				17/4/45 to 11/7/45 then changed to Central Germany.	8 wks
Munich	15/02/45				15/4/45 to 21/6/45	8 wks
Nuremburg	15/04/45	28/04/45	10/05/45	24/05/45	26/05/46	5.5 wks
C.Germany	21/05/45	27/05/45	10/06/45	09/07/45	11/07/45	6 wks
Jutland	15/04/45	07/05/45	28/05/45	20/07/45	25/7/45 to 11/5/46	13.5 wks
Carc/Rhone	11/05/45	11/06/45	18/06/45	26/07/45	19/07/45	9 wks
Loire	15/10/45	19/12/45	10/01/46	01/04/46	08/04/46	6 months
Bari	10/07/45		27/08/45	06/09/45	5/9/45 to 9/3/46	7.5 wks
Naples	20/06/45	17/07/45	22/07/45	20/08/45	17/8/45 to 2/4/46	8 wks
Leghorn	01/08/45	01/09/45	12/09/45	05/10/45	5/10/45 to 2/4/46	9 wks
Tunisia	02/06/45	10/10/45	07/11/45	07/01/46	10/1/46 to 2/4/46	7 months
Tripoli	16/05/45	31/08/45	30/10/45	05/02/46	29/1/46 to 2/4/46	8.5 mo.
Palestine		15/09/45	01/10/45	01/02/46	Av. Dec 45; Optl only 3 weeks	8.5 mo.
Persian Gulf		06/08/45	27/11/45	01/12/45	Av. Oct 45 ; never optl.	8 mo.
Karachi	21/04/45	21/11/45	24/12/45		Eqpt arrived Jan 46; never optl.	
Poona		30/10/45	13/12/45	08/04/46	31/3/46 to 21/5/46	6 mo.
Madras		27/09/45	13/12/45		Inst Dec 45; never optl.	8 mo.
Calcutta			04/01/46		Inst Feb/Mar 46; never optl.	10 mo.
Delhi	31/6/45	20/09/45	31/10/45	01/02/46	Inst Jan 46; Op 1/3/46	8 mo.
Rangoon	28/09/45	16/01/46	18/02/46		abandoned Apr 46	
Singapore	28/09/45	12/02/46			abandoned May 46.	

The deployment of overseas GEE chains. TNA AIR 2/7313.

probably happen today! There are, unfortunately, no notes on the time it actually took to build each station, but since the Type 100 was a self-contained mobile unit transported on trucks, with its own generators, and the aerials were fairly small 100 ft types, they could presumably simply drive onto the site, erect the aerial, get the generator going and be on the air within a few hours. Apart from the usual domestic supplies, all they would need from outside sources was fuel for the generators.

The list of 28 chains is comprehensive and of considerable historical interest, being the only authoritative dated listing of overseas GEE chains so far discovered. It includes tactical chains erected in Germany which were moved about and were not part of the Far East extension. It is not certain which of the remainder were included in Fennessy's ‘fourteen chains’. The French chains became semi-permanent after the war and if they are excluded then there were only fourteen if all of those listed from Bari to Singapore are included, although Fennessy's map stopped at Rangoon. The list is reproduced here in full.

The operational periods are of particular interest and the list confirms Martin's involvement with a chain in Delhi in January 1946 and one near Calcutta a month or two later. Of the Indian chains, it appears that only the Poona and Delhi chains ever became fully operational, and then not for long.

Some years ago I was told by an ex-RAF radio mechanic who had been in the Far East that the Delhi chain was offered to the Indian Air Force, who operated it for some time until it broke down and spares became unobtainable, but I have been unable to find any documentary evidence for this. An interesting sidelight on this is that in 1955, while navigating a Hastings of No 99 Sqn along the route, I idly switched on my GEE set while in the area of Karachi and was surprised to see strong GEE signals appear. I had always previously assumed that it was a stray skywave from the UK chains, but now I wonder whether someone had found the old GEE transmitters and was trying them out!

Since it is certain that all the Indian chain equipment arrived, probably in a single shipment, and most of it was at least installed and put on the air, even if it never became fully operational, there must have been substantial quantities of GEE-related material in India when the war ended. Apart from the Delhi chain, it would all have been

abandoned around mid-1946. What happened to it after that is not known but, amidst the general chaos of personnel repatriation, I rather suspect that it would have ended up in the Indian bazaars as scrap metal, as did so much other wartime material. When I arrived in Singapore in 1950 as a sprog navigator, but a keen radio amateur, I found that practically any item of wartime radio/radar equipment could be found for a few dollars in Singapore's Bugis Street bazaars. Even better were those in Manila which were full of American surplus, but there was a transport problem with that!

Of the non-Indian chains in the accompanying list, several survived for some time. The French Loire, Rheims and Carcassonne chains were given to the French Air Force, which continued to operate them until 1950, and the Central Germany chain was kept operational by the RAF until 1967 to support 2TAF. All the other GEE chains were closed in 1970.

Notes:

[1] Influential in the development and deployment of the Chain Home radar system from as early as 1938, Edward Fennessy spent the war on the staff of No 60 (Signals) Gp, his notable contribution being acknowledged with an OBE in January 1944. He was demobilised in 1945 as a squadron leader, acting group captain, Tech (Sigs). He continued to work in the post-war electronics industry, notably with Decca, and was knighted in 1975.

[2] In 1995 the Centre for the History of Defence Electronics (CHiDE) was established within Bournemouth University to record, preserve and disseminate information relating to developments in electronics particularly during the period 1930-60. In 2002 it ceased to operate as a separate entity, its ongoing research activity being subsumed into the Oral History Research Unit which also ceased to operate not long afterwards. The erstwhile Friends of the CHiDE continue its work today as the Defence Electronics History Society (DEHS).

[3] Fennessy, Sir Edward, 'Radio Aids to Navigation – The Pioneer Days' in the *Journal of Navigation*, Vol 32, No 1, pp1-16 (1979).

BOOK REVIEWS

Note that the prices given below are those quoted by the publishers. In most cases a better deal can be obtained by buying on-line.

The Sky Their Battlefield II by Trevor Henshaw. Fetubi Books; 2014. £50.00 – hardback, £40.00 – softback plus P&P (see http://theskytheirbattlefield2.com/).

The first edition of TSTB appeared, to universal acclaim, in 1995. Its subtitle, *Air Fighting And The Complete List Of Allied Air Casualties From Enemy Action In The First War*, summarised the content which embraced the personnel of the British, Commonwealth and US Air Services. It was a remarkable work which provided a note on every casualty, POWs and wounded as well as fatalities. The details generally included the date, time, unit, serial number of the aeroplane, the nature of the sortie being flown, the names of the crew, their fate and, in the case of an air combat, and where known, the probable identity of the victor. This information was presented chronologically with frequent interjections recording, for instance: changes in tactics; the arrival of additional squadrons or a new type of aeroplane; preparations for specific offensives and their subsequent conduct. The latter involved, often daily, remarks providing an insight into the way in which air activity interacted with action on the ground and reflecting such factors as the impact of the weather. The scope was not confined to the Western Front and losses incurred over the UK and the North Sea, Italy, Mesopotamia, Macedonia and elsewhere were covered in similar depth. Finally, there was an index recording every allied airman named in the book. Reviews featured words like ‘monumental’ and ‘definitive’ and it seemed hardly likely that it could be improved upon.

But it could. After another 19 years of burrowing into German and American, as well as British, records, Henshaw has published an extensively revised and much expanded edition. Retaining the original format, it runs to 406 A4 pages. Needless to say, TSTB II serves to correct errors that appeared in the first edition, but this is a secondary consideration as there were relatively few of these. The major advance is the inclusion of additional combat casualties that have come to light and the provision of a great deal more detail relating to many of those

that had originally been noted. In particular, research among German records has permitted many more of these losses to be matched with the most likely German combat claims. In addition to providing details of combat casualties, the book now includes accidental losses that occurred on active war fronts and on operational units in the UK, including Service Squadrons spending time as training units prior to their mobilisation,[1] and a much expanded section devoted to tabulated statistics providing analyses over time of incidents by nature of casualty, by style of operation and by aircraft type.

Some other statistics will convey some idea of the breadth and depth of the book's content. It contains: more than half-a-million words; references to some 13,500 individuals who became casualties in the course of an operational sortie and more than 3,200 who were injured or killed in accidents (or, in both cases, who were flying with someone who did); and it identifies some 3,250 who-(probably)-shot-down-whom links. The text is enlivened by three photographic inserts providing 289 well-captioned images, many of which are new (at least to this reviewer). I could go on but members are referred to the website noted above for additional details where they will also find, as a bonus, that the author has compiled an additional index recording all of the German and Austrian air personnel whose names appear in the book; this can be downloaded free of charge.

It is tempting fate to describe any book as 'definitive' but, in the context of WW I casualties, TSTB II is as close as we are ever likely to get. Furthermore, it is not just 'a list of casualties'; the author's numerous, and very well-informed, interjections, which run to some 190,000 words, provide a detailed account of the conduct of the war in the air on an almost daily basis. This book is the product of meticulous research, checked, cross-referred and checked again by a writer who has been dedicated to his self-imposed task for many years. Published, most fittingly, 100 years after the beginning of WW I, this book is indispensable to the student of air operations in that conflict.

CGJ

[1] Details of RFC/RNAS/RAF/AFC fatalities that occurred in Reserve and Training Squadrons, may be found in the other authoritative published source on British and Commonwealth casualties, Chris Hobson's *Airmen Died in the Great War, 1914-1918* (Hayward, London, 1995).

Hunter Boys by Richard Pike. Grub Street; 2014. £20.00.

Previous books in the 'Boys' series from Grub Street contained personal accounts, mainly from aircrew, of their experiences with the aircraft type reflected in the titles, but *Hunter Boys* is slightly different. In the light of its world-wide service use, Richard Pike has expanded the search for contributors, capturing a wide variety of stories beyond just the Royal Air Force and Royal Navy. Two chapters are written by Harry Anwar, a Pakistani exchange officer with the RAF, whose later experience as a contract instructor at the Royal Jordanian Air Force Hunter OCU influenced the performance of Jordanian pilots who acquitted themselves well against Israeli Mirages. Another foreign source gives a dramatic account of combat operations over the Indian subcontinent where the Queen of the Skies had its baptism of fire with the Indian Air Force.

The contributors have written entertaining and informative tales of success, heroics, fear, relief and exhilaration, in and around the Hunter cockpit, although some of the stories divert from strictly Hunter business to more general fighter pilot material, some of which has been published previously. The extract from *Test Pilot*, the autobiography of Neville Duke, the Hunter pilots' hero, published in 1953 is a justifiable diversion where most of the relevant chapter deals with his earlier wartime cockpit experience before he became a test pilot at Hawker's. Original words from the indomitable Al Pollock give an emotional and vivid account of the famous episode where he flew his Hunter FGA9 through Tower Bridge in April 1968 as a demonstration of his disappointment and personal frustration at the government's failure to recognise the significance of the 50th birthday of the Royal Air Force. Formation aerobatics and the creation of the two great RAF Hunter teams, Treble One and Ninety Two, are described by the well qualified Brian Mercer who had previous wide experience in the discipline both on a Venom team in the Far East and as a member of the Black Arrows, before commanding the Blue Diamonds for two seasons. A unique and particularly interesting chapter is a wartime diary written by an Indian pilot describing the action in the 1971 Indo-Pakistani war. Although his name is known he could not be traced but his colleagues encouraged the publication of the dramatic day-to-day account of action which was offered to Richard Pike. The diary describes vividly the tensions and successes

of twelve days of intense active service. Despite the span of these contributions, bearing in mind that there were some twenty-four RAF Hunter front line squadrons spanning sixteen years and a few RN units, manned by almost one thousand Hunter squadron pilots plus trainees, it is disappointing that a wider selection of home grown material has not been assembled.

There are a couple of minor typos where Brian Mercer inadvertently describes displaying a Hunter at Saigon in 1956, when he was actually driving a Venom, and the unidentified Indian Hunter pilot's assertion that he had fired a single burst of 386 rounds of gun ammunition in a little over one second – hardly credible when the rate of fire for four Adens was a total of 80 rounds per second. The book is well illustrated with sixteen full pages of original colour and black and white photographs, arranged randomly, plus numerous original part-page black and white photographs which illustrate individual chapters. Not surprisingly it is a readable book for the Hunter enthusiast, but it doesn't qualify as essential reference material for the bookshelf.

Gp Capt Jock Heron

The Design and Development of the Hawker Hunter – The Creation of Britain's Iconic Jet Fighter by Tony Buttler. The History Press; 2014. £20.

Many books have been written about the Hawker Hunter, the handsome jet fighter which emerged from Sidney Camm's Kingston design office in 1951 as the P1067. Tony Buttler's most recent book coincides with the 60th anniversary of the Queen of the Skies' introduction to service with No 43 Sqn at RAF Leuchars. Its title might suggest that this book is merely an excuse to publish a large and varied collection of Hunter-related photographs and drawings of the classic design, but this cynical view would be grossly unfair. The author has been given access to the Hawker archives at Brooklands to research previously unpublished material, hence the book's lengthy title. His purpose was 'to study how the Hunter jet fighter came into being, to catalogue its development and to describe some of the flight testing to prepare the aircraft for service.' These aspects he covers admirably in his book which is profusely illustrated within its 166 pages. Many of the photographs are in colour and this splendid publication is worthy of a hard cover but, sadly, it is merely a

paperback.

Many of the designs considered by Camm's team are illustrated, both by models and line drawings, beginning with the early swept wing prototype P1052 of 1948. These include many related projects, some of which were being studied until well after the Hunter had entered service, such as the radar equipped and missile armed P1135 night fighter of 1959. Various airframe options were studied, including a delta wing, a nose intake and a selection of tailplane positions before the P1067 design progressed to become the graceful aircraft which many of us were privileged to fly. The author resists the temptation of expanding the narrative to include the Royal Air Force's employment of the Hunter, other than addressing the design and performance shortcomings of the early marks which were rushed into service, probably prematurely, during the Cold War. These problems were identified speedily by A&AEE and the Central Fighter Establishment during development and therefore justify complete chapters. Insufficient internal fuel, handling at high angles of attack, inadequate powered flying controls, engine problems caused by gun firing, the absence of effective air brakes and damage caused by Aden cannon-link disposal were the principal problems identified – and fixed. The author's unfamiliarity with aircraft handling is evident in his quotes from extracts of trial reports and some of his descriptive material but his account covers the thinking behind specification F3/48 which was the starting point for the day fighter requirement OR228.

The imagination and enterprise of the Hawker designers shine through the proposals, most of which were unknown to the average front line Hunter pilot, but they serve to confirm that Kingston was not content to mark time awaiting formal contracts to develop the Hunter's capabilities. Options that were explored included wing tip fuel tanks, air-to-air missiles, more powerful engines, increased wing area, reverse thrust, an area-ruled fuselage and a thinner wing together with steeper sweep back. Some of these initiatives were flown and are illustrated, including the elegant P1109, based on the Hunter F6 but with a lengthened nose incorporating the Green Willow AI20 radar and twin Firestreak missiles. The great majority of these potential improvements were not pursued by the Royal Air Force over the years, although Hunter F6 conversions to FGA9 and FR10 standards

were to become important assets in the 1960s.

History shows that the Hunter served the Royal Air Force front line, in several roles, for some sixteen years and was exported widely. So the amount of new descriptive material, together with the wide collection of photographs, many previously unseen, will commend this book to every Hunter enthusiast. Inevitably there are a few minor typos, such as an incorrect abbreviation for air commodore, some caption inaccuracies and on page 99 the Central Fighter Establishment's trials squadron is wrongly titled as the Air Fighting Development Unit. However the most picturesque error is the caption which accompanies the photograph of Hawker's private T7 on page 39, which is described as carrying 'huge 230 gal drop tanks'. The 230 gal underwing tanks were carried routinely by both the FGA9 and FR10 but G-APUX is pictured carrying two experimental 350 gal underwing fuel tanks. These really were 'huge' and were being assessed as a trial installation around 1960 but only the dedicated Hunter man would notice or care! Nevertheless this excellent record of the Queen of the Skies is a must for the book-shelves of such enthusiasts.

Gp Capt Jock Heron

Hawker Hunter by Neil Robinson; illustrated by Jon Freeman. AIRfile; 2014. £23.99.

Hunter books – and still they come! This one is an 88-page A4 softback, sub-titled *In RAF Service*, and devoted solely to the colour schemes sported by this iconic aeroplane. The bulk of the illustrations are side elevations, amply supported, where appropriate/necessary, by plan and underside drawings showing the way in which the RAF's Safety and Surface tradesmen, the erstwhile Painters and Dopers, did their stuff in accordance with AP 2656A (until the dissolution of TG13b in 2006/7 when, along with so much else in our constantly shrinking air force, surface finishing was farmed out to contract).

Although a majority of the aeroplanes illustrated wore the standard grey/green camouflage this book is aimed primarily at the modeller and for them the devil is in the detail. Each drawing is, therefore, based on photographic evidence of a particular aeroplane (I made it 160 of them) at a particular point in its career and the image is supported by a lengthy caption amplifying what can be seen. We are

presented with examples of most of the squadron bar markings and the various ways in which they were applied. Even these relatively drab Hunters could be enlivened by splashes of colour, notably 'Suez stripes' and a variety of yellow or red spines, fins and wingtips applied by some of the aeroplanes operated by the CFE, TWU, A&AEE and others – and then there were the overall black and blue aeroplanes flown by the aerobatic teams fielded by Nos 111 and 92 Sqns. In the Hunter's role as a trainer, we are provided with numerous silver (later grey) T7s sporting the original yellow 'trainer bands', a variety of dayglo embellishments and, ultimately, the spectacular red/white/grey of the 1970s as worn by the F6s of No 4 FTS. Along the way there are many examples of one-offs, including the duck egg green prototype P1067, Neville Duke's all red F3, the ETPS's 'raspberry ripple' schemes and the RAE's green and white T12. Oh yes – and there are some 45 photographs, mostly in colour.

If you are a modeller or have an interest in camouflage and markings you will find this a very useful work of reference. On the other hand, if you just love Hunters this one is almost irresistible.

CGJ

Blue Diamonds – The Exploits of 14 Squadron RAF 1945-2015 by Michael Napier. Pen & Sword; 2015. £20.00.

Noting that Mike Napier's excellent first volume of the history of 14 Squadron, *Winged Crusaders*, covered the period up to the end of World War Two, I have been eagerly looking forward to his finding time in his busy life as a British Airways captain to write the next phase of the squadron's fascinating history. This he has now completed and *Blue Diamonds* relates the history of the squadron from 1945 until the present day.

This comprehensive, and well-illustrated history, covers seventy years of continuous service. Each chapter deals with a particular aircraft type starting with the Mosquito period followed by a chapter on the Vampire/Venom era. Next comes seven years with the Hunter and another seven with the Canberra. The Phantom, Jaguar and Tornado periods follow before the squadron re-deployed to Lossiemouth in 2001. Ten years later the squadron was re-equipped with the Shadow to operate in the Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) role.

So, the period of history covered by this book encapsulates virtually all the operational scenarios that the RAF has been involved in since the Second World War. Fifty-five years of service in Germany in the fighter, ground attack and strike roles included action during the First Gulf War, the air campaigns in the former Yugoslavia and policing the airspace over Iraq. After action in the Iraq War, there was no respite for the squadron as it went on to play a key role during the long Afghanistan campaign where it was serving until the final withdrawal of British forces.

With that amount of service, matched by few other squadrons, this book is rather more than just an account of a squadron and its people. It embraces virtually every aspect of the county's foreign policy and the resulting air operations mounted to meet that policy. It could be a turgid monologue if the author had stuck rigidly to a structure based on the responses to political requirements but he avoids that risk by encapsulating the most important features that make a squadron work, the human dimension and the exploits of its people.

As a Cold War warrior, this reviewer was taken back over a wave of nostalgia to the period when TACEVAL, QRA, duty-free and an RAF with dozens of squadrons was the norm. But there is much more, indeed twenty-five years of more, when RAF squadrons participated in very different kinds of warfare and this will provide great interest to my generation of aircrew and create a feeling of immense admiration for those who have gallantly fulfilled some very demanding tasks in recent years.

No 14 Sqn has a long and proud history and, as a former CO of the squadron, Air Marshal Sir Timo Anderson, mentions in his Foreword to the book; 'By any measure, the squadron has provided much more than a footnote in the development and delivery of UK air power and this record is a fittingly detailed testament to its achievements and to the men and women who made them possible.'

A squadron, and its people, is the fundamental unit of the RAF. Sadly, over the years, publishers have seemed reluctant to produce squadron histories but, as so many of our famous squadrons disappear, almost certainly never to re-appear, it is more important than ever that their historic exploits should be recorded for future generations. Mike Napier is to be congratulated on producing such a comprehensive history of one of the RAF's longest-serving and most important

squadrons.

I would also add to that thanks to Pen & Sword for agreeing to publish the book. In the past, I have criticised the production of some of their publications, but this 320-page hardback is extremely well produced on very good paper, with good clear photographs and twelve colour profiles of individual aeroplanes. The author has also included a number of detailed appendices and I particularly liked the biographical notes on personnel who have served on the squadron.

This is an excellent squadron history and I wish there were more like it. Those with an interest in RAF history will find it a fascinating read. Recommended.

Air Cdre Graham Pitchfork

Images Of War – Aircraft Salvage In The Battle Of Britain by Andy Saunders. Pen & Sword; 2014. £14.99.

This is the latest in a series of photograph-centric softback publications from Pen & Sword. It might be tempting to pigeon-hole it as a rehash of familiar material. In reality, it provides an important record of the RAF's salvage operations in the UK during the first 18 months of the war. The coverage is largely, but not exclusively, German fighter and bomber aircraft in various conditions of distress or disassembly. There is a useful introduction – perhaps too short – and some 150 well-captioned images. As such, it neatly complements this reviewer's article on the RAF repair and salvage operation published in Journal 51 (pp 111-123). Because of the format, there is no index or bibliography – which is an opportunity missed. There is an interesting history yet to be written on the work of No 43 Group Salvage and No 50 MU, based at Cowley. At £14.99, this is a not particularly expensive offering that will appeal to the Battle of Britain enthusiast and those with a more general interest in the RAF's support organisation. I note that Pen & Sword has recently reduced the on-line ‘Sale price to just £12.00.

AVM Peter Dye

Billy Bishop VC – Lone Wolf Hunter by Peter Kilduff. Grub Street; 2014. £20.00.

Most members of this Society will be aware that the validity of some of Billy Bishop’s 72 credited WW I victories has long been disputed. Many, indeed most, of his claims have proved difficult to

verify, not least the three enemy aircraft he shot down on 2 June 1917 in the course of a remarkable solo attack on an unidentified German-occupied aerodrome. This exploit earned him a Victoria Cross, a unique instance of such an award being made solely on the basis of the entirely uncorroborated account of the recipient. Previous accounts of Bishop's career have questioned the veracity of many of his combat claims, as did a CBC TV programme broadcast in 1982. As Bishop was one of the most highly decorated Canadians of WW I and a national hero, this led to a Senate-level enquiry which criticised the TV production but signally failed to substantiate Bishop's claims.

Peter Kilduff is a well-known writer on the aviators of WW I and among his many previous titles are accounts of such notable individual German pilots as von Richthofen, Degelow, Goering and Berthold. One anticipated, therefore, that this new appreciation of Bishop – it is subtitled *The RAF Ace Re-examined* – might lay to rest the long-standing controversy associated with his name. Sadly, but perhaps inevitably, it fails to do so. The author goes over the ground again in a meticulous attempt to reconcile each claim but, as with previous essays by other writers, he has encountered the same problem – the surviving German records are frustratingly vague. Kilduff provides a detailed annex that tabulates each of Bishop's victories of which he has classified at least 50 as 'no matching loss found', 'witnessed but no matching loss found' or 'German records incomplete'. But, despite this lack of positive evidence, he still declines to pass judgement 'until it can be conclusively proven that the events did not take place as described.' So Bishop gets the benefit of the doubt and we are none the wiser.

That aside, the book provides an, amply end-noted, account of Bishop's childhood, his courtship and marriage, and his wartime career topped off by a two-page summary of the rest of his life. There is a significant error in the context of Bishop's early flying experience as an observer. On page 35 we are told that he had been awarded his observer's badge before he went to France with No 21 Sqn on 18 January 1916, but that this was not formally acknowledged until as late as 15 November. Until August 1918 *all* observers were initially on probation and 'O' badges were never awarded until the recipient had seen active service. Bishop was not graded as a 'qualified

observer', and thus entitled to put up his badge, until 4 March,[2] some six weeks after his arrival in France, which was about par for the course. The significance of the 15 November is that it was the date on which the War Office belatedly permitted those observers already holding the necessary qualification certificates, up to a maximum of twelve per squadron, and not already formally gazetted to the RFC as a 'flying officer (observer)' to be so gazetted.

If you are not already familiar with William Avery Bishop and his war record, this is an excellent account, but it fails to lay to rest conclusively the lingering doubts about the veracity of many of his claims.

CGJ

Valiant Boys by Tony Blackman and Anthony Wright. Grub Street; 2014. £20.00.

As an aviation historian, I applaud the motivation behind the Grub Street 'Boys' editions. Without the people who operated, sustained and supported military air power down the ages, even the most sophisticated and glamourous warplane is nothing more than a collage of shiny metal and gee-whizz gizmos. Which is why it is so important to capture the recollections and impressions of the aircrews and groundcrews of yesteryear before it is too late.

The gold standard for the 'Boys' genre was set by Graham Pitchfork's *The Buccaneer Boys*. In part this is because Graham can write, but also because he was himself a dyed-in-the wool Buccaneer boy who weaved together a compelling narrative crafted by a close-knit band of brothers in arms. By comparison, former test pilot Tony Blackman never served on a Valiant (or Vulcan or Victor) squadron. So this book is a bit of a mish-mash of random and unstructured recollections by various Valiant mates who have sent in their recollections.

I sought an opinion from a friend who served as a Valiant armourer. 'The book is quite interesting, but it might be teaching some people how to suck eggs. It all depends on your point of view. To me it was fascinating learning what you chaps used to get up to. It is not too long. I read it in an afternoon.'

[2] HQ RFC Routine Orders for 6 April 1916 (TNA AIR1/872/204/5/552) .

Valiant Boys is redeemed by the efforts of its co-author, Anthony Wright. Tony was a Nav Radar on Valiants and then Vulcans and his chapters on 148 Squadron and the Low Level Deterrent are both original and well worth reading, as is the *pot-pourri* of Valiant tales submitted by the old and bold.

One of the most interesting sections in the book relates to the main spar metal fatigue problem which grounded the whole Valiant force at the end of 1964. It is easy, with hindsight, to blame the use of the alloy DTD 683 but in their quest for better performance after 1945, aircraft engineers became very weight conscious and they rejected the old wartime light aluminium alloys in preference for new high-strength, light zinc-bearing DTD 683 forged alloys. These double heat-treated plates were extremely strong as well as light, but in time these alloys tended to become brittle with a high propensity to stress fatigue, corrosion and a high crack propagation rate. 'DTD 683 was a bad mistake by the Ministry of Supply,' said one senior Vickers man, 'but we did not have the range of alternatives that we have today [. . .] If we had known then what we know now about DTD 683 we would not have used it, but if we hadn't used 683 the aircraft would have been much heavier or we would have had a gap of 7-10 years before alternative materials became available to build an aeroplane that did as well as those Valiants.' These are the decisions with which operational commanders, engineers and politicians have to wrestle. It's a pity that Tony Blackman doesn't make due allowance for this.

Unlike the more glamorous Vulcan and Victor, there is a dearth of first-hand material on the Vickers Valiant which is a great pity because this 'interim' V-bomber paved the way in so many respects for the rest of the V-force. The Valiant's designer, Sir George Edwards, recalled that Vickers was 'given no mercy; because we could not build flying scale models: it had to be right first time', and the fact that it was right and appeared at the right time for the right price demonstrated everything that was great about the British aviation industry. The Valiant and those who operated it have been sadly neglected, so do buy this book and help to set the record straight.

Wg Cdr Andrew Brookes

ROYAL AIR FORCE HISTORICAL SOCIETY

The Royal Air Force has been in existence for more than ninety years; the study of its history is deepening, and continues to be the subject of published works of consequence. Fresh attention is being given to the strategic assumptions under which military air power was first created and which largely determined policy and operations in both World Wars, the interwar period, and in the era of Cold War tension. Material dealing with post-war history is now becoming available under the 30-year rule. These studies are important to academic historians and to the present and future members of the RAF.

The RAF Historical Society was formed in 1986 to provide a focus for interest in the history of the RAF. It does so by providing a setting for lectures and seminars in which those interested in the history of the Service have the opportunity to meet those who participated in the evolution and implementation of policy. The Society believes that these events make an important contribution to the permanent record.

The Society normally holds three lectures or seminars a year in London, with occasional events in other parts of the country. Transcripts of lectures and seminars are published in the Journal of the RAF Historical Society, which is distributed free of charge to members. Individual membership is open to all with an interest in RAF history, whether or not they were in the Service. Although the Society has the approval of the Air Force Board, it is entirely self-financing.

Membership of the Society costs £18 per annum and further details may be obtained from the Membership Secretary, Wg Cdr Colin Cummings, October House, Yelvertoft, NN6 6LF. Tel: 01788 822124.

THE TWO AIR FORCES AWARD

In 1996 the Royal Air Force Historical Society established, in collaboration with its American sister organisation, the Air Force Historical Foundation, the *Two Air Forces Award*, which was to be presented annually on each side of the Atlantic in recognition of outstanding academic work by a serving officer or airman. The British winners have been:

1996	Sqn Ldr P C Emmett PhD MSc BSc CEng MIEE
1997	Wg Cdr M P Brzezicki MPhil MIL
1998	Wg Cdr P J Daybell MBE MA BA
1999	Sqn Ldr S P Harpum MSc BSc MILT
2000	Sqn Ldr A W Riches MA
2001	Sqn Ldr C H Goss MA
2002	Sqn Ldr S I Richards BSc
2003	Wg Cdr T M Webster MB BS MRCGP MRAeS
2004	Sqn Ldr S Gardner MA MPhil
2005	Wg Cdr S D Ellard MSc BSc CEng MRAeS MBCS
2007	Wg Cdr H Smyth DFC
2008	Wg Cdr B J Hunt MSc MBIFM MinstAM
2009	Gp Capt A J Byford MA MA
2010	Lt Col A M Roe YORKS
2011	Wg Cdr S J Chappell BSc
2012	Wg Cdr N A Tucker-Lowe DSO MA MCMI
2013	Sqn Ldr J S Doyle MA BA
2014	Gp Capt M R Johnson BSc MA MBA

THE AIR LEAGUE GOLD MEDAL

On 11 February 1998 the Air League presented the Royal Air Force Historical Society with a Gold Medal in recognition of the Society's achievements in recording aspects of the evolution of British air power and thus realising one of the aims of the League. The Executive Committee decided that the medal should be awarded periodically to a nominal holder (it actually resides at the Royal Air Force Club, where it is on display) who was to be an individual who had made a particularly significant contribution to the conduct of the Society's affairs. Holders to date have been:

Air Marshal Sir Frederick Sowrey KCB CBE AFC
Air Commodore H A Probert MBE MA

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