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Cover picture: A Tornado F3 having just refuelled during Operation IRAQI FREEDOM. Crown copywright

CONTRIBUTIONS TO THE ROYAL AIR FORCE AIR POWER REVIEW

The Royal Air Force *Air Power Review* is published quarterly under the auspices of the Director of Defence Studies (RAF) and has the sponsorship of the Assistant Chief of the Air Staff. It is intended to provide an open forum for study which stimulates discussion and thought on air power in its broadest context. This publication is also intended to support the British armed forces in general and the Royal Air Force in particular with respect to the development and application of air power.

Contributions from both Service and civilian authors are sought which will contribute to existing knowledge and understanding of the subject. Any topic will be considered by the Air Power Review Management Board and a payment of £200 will be made for each article published.

Articles should be original and preferably not previously published, although those of sufficient merit will not be precluded. Between 2,000 and 10,000 words in length, articles should list bibliographical references as end notes, and state a word count. Lengthy articles may be published in installments. Contributions from serving military personnel should be in accordance with DCI GEN 313 dated 26 November 1999.

Material should be submitted in Microsoft word, on floppy disk, Zip or CD and should be accompanied by numbered page copy plus any photographs and illustrations. Digital pictures should be saved as TIFFs or JPEGs @ 300dpi. Final design format for article presentation on the printed page will be at the discretion of the Editor.

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FOREWORD

The leading article for this issue of the *Air Power* Review looks at the air aspects of Operation IRAQI FREEDOM with a view to informing the forthcoming rewrite of AP3000, British Air Power Doctrine. The article summarises the chronology of the air campaign, and then examines sortie rates and weapons usage rates, in comparison to Operation DESERT STORM and other post-Cold War air campaigns. The article then goes on to discuss what appears to me to be the three key aspects of the air campaign namely: the resurgence of the air/land battle; and the interrelated subjects of effects-based operations and net centric warfare. It then draws a number of specific lessons about the air campaign and concludes by suggesting that whilst the five effects-producing core capabilities of air power remain valid, we should now consider there to be three supporting elements, namely: force protection, sustainability, and space. Furthermore, whilst these basic concepts of the categorisation of air power remain valid, the technology, and the campaign planning and command and control philosophies, continually develop to maximise their effectiveness.

The 17th December 2003 of course marks the centenary of the first manned powered flight. Air Marshal 'Black' Robertson's article takes a look at the last 100 years of aviation from a human perspective, using a series of vignettes ranging from the early pioneers of flight through to more recent events, such as the 1969 Trans-Atlantic Air Race and the first manned powered flight across the English Channel in 1979. The underlying theme of the article, however, is that whilst aviation has always, by definition, been at the cutting edge of technology, it has only been through the efforts, bravery and sometimes foolhardiness of man that so much has been achieved in just 100 years.

The next article, by Air Commodore 'Timo' Anderson, who is currently the Director of Equipment Capability (Deep Target Attack), is based upon an earlier presentation he made at RUSI in May 2003. The article examines the United Kingdom's long range offensive air power requirements for 2020 and beyond in the context of the Future Offensive Air System (FOAS) programme, which is nearing its 'initial gate'. This timely paper explores developing thoughts on what might be required of the UK's future long range offensive air power capability, but is set within the overall context of the UK's evolving defence needs. Having described the geopolitical and conceptual framework, the paper then looks at enabling technologies. The context for this is the increasing emphasis on the use of precision-guided munitions, against a range of fixed or moving targets, in all conditions of light level and weather, and within an effects-based campaign. It goes on to examine key system attributes, such as reach, responsiveness and presence, which FOAS will need to possess. The paper then examines the challenges to the delivery of the FOAS capability, in particular those of technological risk and C4ISR. The paper concludes by highlighting FOAS's role in the future in delivering air power's fundamental capability, 'precision effect at range, in time'.

By way of light relief, Lieutenant Colonel Nedyalkov's article is a fascinating read, particularly for those of us who could have come up against the MiG-21 had the Cold War turned hot. The fighter pilot language in the article has been left unedited, which gives a strong impression of this pilot's enthusiasm for his aircraft.

The next article, by William D O'Malley and Roger N McDermott stays with the Russian theme, addressing a deployment of Russian Air Force frontal and military transport aviation to Kyrgyzstan in late 2002. The deployment was under the aegis of the Russia, Kazakhstan, Kyrgyzstan and Tajikistan collective security treaty as part of the development of multi-national collective rapid deployment forces. The article makes the point that Kyrgyzstan and, by implication, the other partner air forces, are extremely weak, and that the CRDF aviation group exists primarily to support anti-terrorist or counter-insurgent operations. The article also provides an interesting external analysis of the effectiveness of

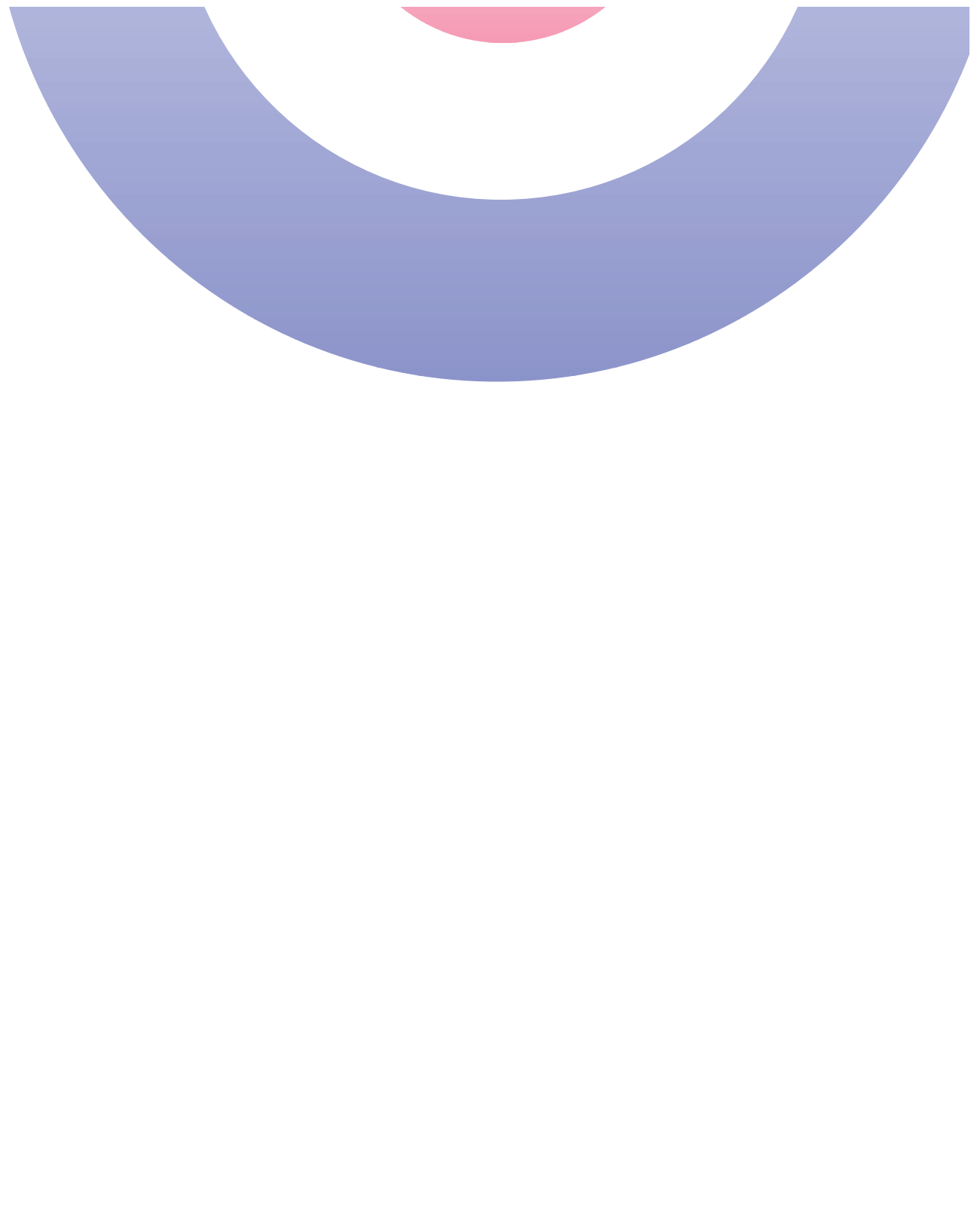
the Russian Air Force during the first and second Chechen campaigns (see also *Air Power Review*, Spring 2003). The article is an interesting balance of political and military comment which is particularly relevant to RAF readers in view of our use of airfields in that region during Operation ENDURING FREEDOM.

Colonel Phil Meilinger USAF (Retired) is no stranger to *Air Power Review* readers, or indeed to anyone in the air power community. His article, 'The Air and Space Nation is in Peril', which is taken from a chapter in his recent book, *Air War: Theory and Practice*, is a polemic on the increasing effect of market forces on the US aerospace industry and, in particular, the impact of the decline in research and development expenditure. Whilst somewhat evangelistic and aimed very much at the American military readership, the article provides a useful counter-point for the received wisdom that US aerospace superiority will always be assured.

The last article, by Francis Hanford, is a historical one concerning the deployment of No 3 Squadron to Halton during the large-scale Army manoeuvres of 1913. The description of the logistics effort involved in deploying the Squadron shows how seriously the RFC had been thinking, even at that stage, about the implications of expeditionary operations: the provision by Mr Alfred de Rothschild of a high tea of hot pies washed down with quarts of beer to 3,000 soldiers on three successive evenings during the exercise is something that officers negotiating host nation support should try to live up to! The flying anecdotes are equally intriguing, in particular how easy it is to draw the wrong lessons from individual events such as the ability of airships to operate in weather which would ground heavier-than-air machines.

The readership of *Air Power Review* has steadily grown since 1998, to the extent that we now produce 7,200 copies per quarter for a readership that spans the UK armed forces and the international air power community. I and the Editorial Board would encourage any of the readership who are seized by any air power issue to air their views in an article in the journal.

D Def S (RAF)



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Contents

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Air Aspects of Operation Iraqi Freedom

By Group Captain Chris Finn

"The art of war is simple enough. Find out where your enemy is. Get at him as soon as you can. Strike him as hard as you can, and keep moving.

Ulysses S Grant (1822-1885)

The aim of this article is to take a first look, from unclassified sources, at Operation IRAQI FREEDOM from an air perspective. The article does not seek to pre-empt the official 'lessons learned' process but to identify the key

2 *On the night of 21 March, the air campaign "began in earnest", with the offensive sortie rate doubling from just over 500 to over 1,000 sorties per day*

areas in which this Operation, and the other major air campaigns of the post-Cold War era, may influence the development of British Air Power Doctrine, AP 3000, which is currently being re-written. Because of the available sources, and the need to keep the article to a manageable length, aspects of the conflict such as the use of Special Forces and Airborne Forces get only a brief mention. Whilst doctrinally incorrect, the term 'Air Campaign' is used as shorthand for 'the air elements of the Joint Campaign'. The article starts with a brief chronology of the air campaign, examines the nature of that campaign, identifies three key areas of interest and, finally, draws some lessons.

In United Nations Security Council Resolution (UNSCR) 1441, the Security Council stated that Iraq was in material breach of its obligations under UNSCR 687 and other Resolutions over the intervening 12 years to comply fully with an arms inspection regime and dismantle its weapons of mass destruction programme. Although diplomatic attempts to secure a further UNSCR failed, both US and UK governments viewed Iraq's failure to comply with the terms of UNSCR 1441 and previous UNSCRs as further material breach of its obligations, thus reviving the authority to use force under UNSCR 678[1].

On 17 March 2003 President Bush gave Saddam Hussein a 48 hour deadline in which to leave Iraq or face military action to remove him from power. The order to begin Operation IRAQI FREEDOM was issued by President Bush on Tuesday 18 March[2] 2003 and the Operation officially began at 0234 GMT on 20 March 2003. However, some operations were carried out on the previous day against Iraqi artillery, surface-to-surface missiles and air defence systems within the Southern No Fly Zone[3]. Later that evening coalition air forces attacked an Iraqi leadership compound in Baghdad[4]. As well as the leadership target of opportunity, intelligence service headquarters in Baghdad and a Republican Guard facility were attacked with nearly forty Tomahawk Land Attack Cruise Missiles (TLAM) and two USAF F117s also took part, dropping precision guided 2,000 lb penetration weapons. On the following day a further thirty TLAMs were launched against leadership and Republican Guard targets. Special Forces teams were inserted throughout Western and Southern Iraq on 19th of March, and on the 20th seized an airfield in Western Iraq and 2 major gas and oil terminals in the Northern Persian Gulf[5].

On the night of 21 March, the air campaign "began in earnest"[6], with the offensive sortie rate doubling from just over 500 to over 1,000 sorties per day at that point. At this stage there was some confusion in the media as to when the war had really begun and when the "shock and awe" air campaign would start. This was clarified in a briefing by CENTCOM Commander, General Tommy Franks[7], in which he reviewed the military objectives of IRAQI FREEDOM, which were:

- End the regime of Saddam Hussein.
- Identify, isolate and eliminate Iraq's weapons of mass destruction.
- Search for, capture and drive out terrorists from the country.
- Collect intelligence on terrorist networks.
- Collect intelligence on the global network of illicit weapons of mass destruction.
- End sanctions and immediately deliver humanitarian support to the displaced and to many needy Iraqi citizens.
- Secure Iraq's oilfields and resources, which belong to the Iraqi people.

He then went on to the clarify that the sequence of operations was S Day, the introduction of Special Operations Forces, followed by G Day, the introduction of ground forces, then A Day, the introduction of shock air forces. The night of 21/22 March 2003 also saw the first operational use of the United Kingdom's Stormshadow missile, released from the GR4 Tornado aircraft and designed for long-range, highly accurate and deep penetration against key regime targets[8].

By 24 March the air campaign had settled down into a pattern of attacks against leadership, command and control, defensive counter-air, now against airfields as well as IADS targets, and also armoured formations[9]. The 24 March was also the day on which a large formation of US Attack Helicopters attacked Republican Guard positions

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near Karbala in advance of the US 3rd Infantry Brigade. The helicopters were subject to heavy anti-aircraft fire, with one being shot down and all sustaining damage. The nature of tasking also appears to have shifted at this point, where of the 1,500 or so sorties flown on 24 March, more than 800 were attack sorties with only 200 of those being flown against pre-planned targets, the rest against emerging targets[10]. The weather began to play a part at this point, with blowing sand and dust and winds affecting in particular rotary wing operations, but the Coalition was able to continue an aggressive integrated operations plan between the air and land components, using all-weather precision-guided munitions, in particular the JDAM, to attack Republican Guard and other targets[11]. Both the Global Hawk UAV and the E8c JSTARS, equipped with synthetic-aperture radars which could detect ground targets through the weather and dust storms, were used to cue these attacks[12].

At this stage, 50% of the offensive missions were being focused on Republican Guard targets. Close air support was being conducted in support of both the ground advance in the south and of Special Forces in the west[13]. Just over a week into the war, despite high wind gusts and sand storms, coalition forces had moved over 200 miles and were now some 50 miles south of Baghdad, having secured Iraq's southern oil fields. The US 173rd Airborne Division had been deployed into the north of the country. Offensive air sorties were continuing at around 1,000 per day, and by that stage more than 650 TLAM and more than 5,000 PGMs had been dropped. Targets continued to be

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With the lack of any credible air-to-air threat, swing—role aircraft were now being employed almost exclusively on attack missions

the Iraqi regime leadership and command and control, ballistic missile threats and major communications nodes, and Iraqi forces, particularly the Republican Guard, continuing to be attacked by both fixed and rotary wing aircraft[14]. However, the subsequent comment by General Myers that "We will engage them with the full weight of our combat power at a time and place of our choosing" demonstrates that major Iraqi formations were not at that stage being directly engaged by ground forces.

At this stage it was also assessed that the Coalition had "air supremacy" over approximately 95% of Iraq, with some surface-to-air missile systems still unlocated in the area between Baghdad and Tikrit, the so-called 'Super MEZ'. However, the Iraqis had not been using their early warning and fire control radars in that area to avoid being located and destroyed, and Coalition air forces were thus able to operate effectively in the MEZ[15]. By this stage, airfields had been secured in both Southern Iraq and in Kurdish territory, the latter being used for combat search and rescue and close air support aircraft, and both being used for logistics support[16]. As the number of pre-planned targets appeared to decline further, more and more targeting was done whilst aircraft were airborne. As Major General Renaurt, the CENTCOM Deputy Director of Operations, said "We have taken advantage of very rapid sensor-to-shooter links in order to retarget our airmen as they move around the country to respond to the situation on the battlefield that the commanders feel are critical to them"[17]. Poor weather, including thunder storms, were still affecting air operations but the pattern of airborne on-call aircraft with tanker support, as had happened in Operation ENDURING FREEDOM, had been established. With the lack of any credible air-to-air threat, swing role aircraft were now being employed almost exclusively on attack missions[18]. But the use of air power was by no means restricted to offensive and their supporting operations, with both leaflet dropping and airborne broadcasting taking place as part of the Information Campaign. There were also reports that at this stage TLAM failures caused the Saudi Arabian government to close some of their airspace to

A global hawk UAV had been operating in the vicinity of Baghdad from the beginning of the conflict

TLAM missiles, and this was confirmed by General Renuart who stated that they had "co-ordinated with the Saudis to hold on a couple of routes that might put them in a position where they could be close to any civilian population" [19].

By 1 April there was heavy fighting in and around Basrah between Iraqi and British forces. The US Army 5th Corps was engaging Republican Guard elements south of Baghdad whilst the 1st MEF consolidated its hold on Nasiryah and was moving northward to form a second access attack against Baghdad. Air attacks continued against all target categories and AC130 gun ships were used in the offensive counter-air role at H-2 airfield in the western Iraqi desert under the direction of Special Forces[20]. Whilst offensive sortie rates remained steady at some 1,000 per day, over the preceding three days the emphasis shifted to close air support and interdiction of four Republican Guard divisions with over 3,000 PGMs having been dropped in those three days, bringing the total to over 8,000 PGMs and 700 TLAMs used since Operation IRAQI FREEDOM began[21]. Information operations had extended to the point where Coalition radio broadcasts could cover all Iraq, and the range of television broadcasts on Iraqi Channel No 3 had been extended; the Iraqi military forces were a specific target audience for these broadcasts[22].

On 2 April, in what was clearly the build-up to the assault on Baghdad, again over 1,000 offensive sorties were flown and approximately 1,000 PGMs released, the targets primarily being the Republican Guard divisions[23], and against regular Iraqi forces in the north of the country[24].
In supporting the advance of the ground forces on Baghdad, offensive sortie rates remained high with a further increase in the use of precision weapons[25]. General Brookes commented in the CENTCOM briefing of 3 April, that "Particularly moving forces are very vulnerable to our air operations and our precision attacks"[26]. Baghdad Airport was taken by Coalition forces on 3 April 2003, and PGM expenditure was running at around 2,000 per day[27], with the Medina and Baghdad Republican Guard divisions ceasing to exist as fighting forces and the effectiveness of the other four being sufficiently degraded by both air

6 *On 13 April, less than 800 sorties were flown and less than 200 PGMs dropped, and the 14th was the last day that aircraft from all five carrier battlegroups would fly concurrent missions into Iraq*

and land attacks. This was described by General McCrystal thus: "What they are seeing is the doctrine and the synergy at work. The way we are designed to fight and are fighting is to use intelligence, surveillance and reconnaissance assets to identify enemy locations and then use our air and long-range shooters, our ATACMs, MLRS and artillery to attrit enemy forces so that when we finally close ground combat in fact it is not an even fight. What we believe we saw in the Baghdad and Medina divisions is, we would have treated both of those formations both materially and also morally to the point where, when the 1st MEF came to the Baghdad division and then the 3rd ID hit Medina division they were incapable of a coherent defence" [28].

The transition in the air war was marked by a Coalition Forces Air Component Command briefing given by the CFACC, Lieutenant General Michael Moseley, on 5 April[29] which gives an excellent overview of the air war to that date. The first key point was that airborne sensors were showing that the preponderance of the Republican Guard divisions outside Baghdad had been destroyed, and that the Iraqi military no longer existed as an organised fighting force. In addition to manned platforms such as JSTARS, Rivet Joint and the Nimrod R1, UAVs were also in constant use. Predators had been operating in the vicinity of Baghdad from the beginning of the conflict and there had been a Global Hawk over Baghdad throughout the conflict as well. The next point was that having developed and practised a concept of operations for a year, an urban close air support system was implemented on 5 April. This involved airborne Forward Air Controllers, in a variety of aircraft over the city 24 hours a day, with multiple formations of attack aircraft with differing weapon loads also stacked 24 hours a day to be able to respond to the Coalition Land Force Component Commander (CFLCC). In addition to this, the capability that existed throughout the conflict to have Special Operations and conventional forces spotting targets and then passing co-ordinates for B1 and B52 bombers to drop JDAMs on, was also seen as an option in the urban CAS environment. Whilst all the targets in Baghdad had to be controlled through CAS mechanisms, leadership and command and control targets were still being attacked outside Baghdad in the normal way.

By 8 April this phase of the air campaign had become one of supporting Coalition ground forces in and around Baghdad, attacking the remaining Republican Guard forces and Iraqi military forces in the north of the country, and attacking potential WMD delivery systems such as surface-to-air missiles and aircraft[30]. However, Iraqi SAM systems were still proving to be effective when an A10 aircraft on a CAS mission at low altitude in the area of Baghdad International Airport was shot down. An attack on a leadership target in the Mansour district of Baghdad led General McCrystal to discuss the time-sensitive targeting process (TST) as "being the linkage of multi-source intelligence to the capability to attack the target very quickly, in that case the process taking some 45 minutes"[31].

Comments on 9 April by Secretary Rumsfeld[32] gave the impression that the offensive air war had almost ceased; sortie rates and weapons utilisation were no longer being discussed in the press briefings. The CENTCOM briefing of the same day[33] referred to ongoing CAS in response to a question about collateral damage in Baghdad. This period also saw the continuing shift in the use of air transport resources to humanitarian relief and logistics resupply, and 101st Airborne conducted a helicopter-borne assault in the north of Iraq on 10 April. Sortie rates were still being reported at about 1,000 per day (although the figure no longer discriminated between offensive and other aircraft sorties), the missions being to provide CAS to ground forces in and around Baghdad and throughout Iraq, and to strike at leadership targets when and where they were found[34]. There was further evidence of the winding down of the campaign in a statement by the UK's Secretary of State for Defence that it was envisaged that a number of fixed and rotary wing aircraft would be withdrawn in the near future, starting with the return of the Tornado F3 over the next few days[35].

On 13 April, less than 800 sorties were flown and less than 200 PGMs dropped, and the 14th was the last day that aircraft from all five carrier battle-groups would fly concurrent missions into Iraq[36]. By 16 April, offensive air operations had decreased further with a significant decrease in the number of PGMs that were dropped, CAS being available to those forces that were still manoeuvring in areas where there may have still been some regime presence[37]. The US CENTAF Assessment and Analysis Division's initial report on Operation IRAQI FREEDOM, 'By the Numbers', put the start of the air campaign at 0300Z 19 Mar 03, and the end at 0259Z 18 Apr 03, a total of 30 days[38].

As Field Marshal von Moltke said, "No plan survives contact with the enemy", but the difficulty in the case of Operation IRAQI FREEDOM is to know, from open sources, what the plan was. General Franks made it clear in a briefing on 22 March[39] that the sequence of initiation of operations was Special Forces, ground forces and then air forces. However in a briefing the previous day[40], which tallies with the CENTAF view expressed in 'By the Numbers', and converting to local time, the ATO cycle started at 2300 hrs D on the night of Thursday 18 March. On the Wednesday there was a pre-planned series of attacks against air defence and air interdiction targets and on the Thursday some 30 TLAMs were launched against leadership and Republican Guard targets. Special Operating Forces were inserted on the Wednesday, and by Thursday had seized airfields in western Iraq, border posts in several locations and two major gas and oil terminals in the northern Persian Gulf[41].

At 1300D on Thursday 20 March, ground forces commenced their advance on Baghdad and their assault on the Al Faw Peninsula. At 0400D on the Friday, the main element of the air campaign started. But what happened at very short notice[42] was the attack on a leadership target of opportunity with the intention of killing Saddam Hussein if at all possible. General Franks' view about that attack, on what he called an emerging target, was that the plan was "a plan that is agile, a plan that is flexible, provides what we call branches to be able to undertake a number of actions at the same time"[43]. However, it is clear that this attack caused S and G Day to be brought forward slightly[44]. What is also clear is that the coalition did not intend to signal the start of the conflict by a massive precursor air campaign, as was the case with the 1991 war.

Towards the end of the conflict Secretary Rumsfeld commented "because of the way General Franks conducted the conflict, a lot of bad things didn't happen. The oil wells were not set afire like they were last time"[45]. This, coupled with the early insertion of Special Operations Forces referred to earlier, makes it clear that the intention was to deny Saddam Hussein time to initiate a 'scorched-earth' policy in the oil fields. General Moseley, in what is one of the two most informative reports on the air campaign[46], the other being the US CENTAF 'By the Numbers' report, suggests that one could go back 11 years to the start of Operations NORTHERN and SOUTHERN WATCH, as one possible start point of the air campaign. Throughout the decade there was a steady attrition the Iraqi integrated air defence system within the No-Fly Zones, that peaked during Operation DESERT FOX in December 1998. However, these operations did not cover the part of Iraq between 33° and 36° north, which included Baghdad and Tikrit, hence the concentration on suppressing and then destroying Iraqi air defence systems within the Baghdad/Tikrit 'Super MEZ' in the opening phase of the air campaign.

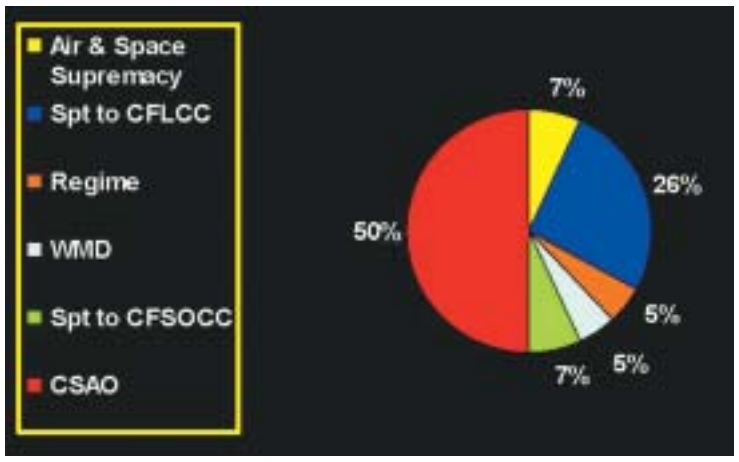
Moseley then went on to state that, "from June of last year (2002) up until the initiation of hostilities we increased our presence in the No Fly Zones to enforce the Security Council Resolutions, and by doing that he shot at us more and more and in doing that we were able to respond more on items that threatened us, the air defence system etc"[47]. Furthermore, on Friday 14 March, five days before the official start of the war, targets including a mobile early warning radar and an air defence command centre in the area of H3 were attacked by two B1B bombers operating from the USA[48]. Irregular peaks of activity above the baseline of daily Southern Watch sorties not only set the conditions for the almost immediate achievement of air superiority south of 33° north after 21 March but also achieved a level of tactical deception in that the attacks of 19 March would be

Once it became apparent that there was no air threat, swing-role aircraft such as the F15E were placed in the on-call 'stacks' with both air-to-air and air-to-ground weapons on board

seen as part of an ongoing pattern. This is supported by Air Marshal Brian Burridge's comment to the House of Commons Defence Committee that "I might say on timing that we recognise that Saddam had expectations about how this campaign would proceed based upon his experience of the previous campaign. The only way we could achieve tactical surprise was to do it a different way"[49].

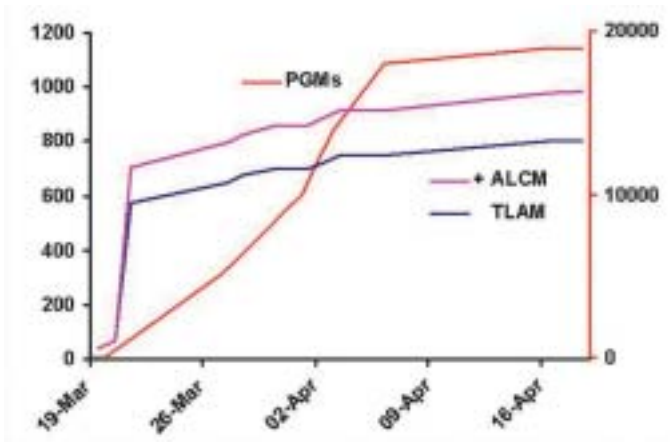
One major change to the plan occurred in January 2003 when, because of doubt about the likelihood of Turkey agreeing to UK forces operating through Turkey, the 'Northern Option' was dropped[50]. This particularly affected the RAF which was planning to operate in significant numbers from Turkey[51]. The UK Government then only had a matter of weeks to agree new basing options to the south of Iraq before the majority of offensive and support aircraft deployed during mid February to early March[52]. Finally, whilst it is not yet clear how long land combat actions were envisaged to last for, the speed of advance was far in excess of that assumed. This is clear from both the misnamed 'operational pause', where the land forces needed to regroup prior to the assault on Baghdad, and the statement in the 101st Airborne Division presentation that, "We planned for FOB seizures and actions in Baghdad, but fought in Najaf, Karbala and Hillah, with the plans for these actions being developed while the entire Division was on the move"[53].

Turning to the air campaign itself, the following pie chart shows the CFACC average approved apportionment[54].



The command and control, ISR, air refuelling and air mobility missions were considered by the CFACC to be the "cost of doing business" and were not included in the daily apportionment calculations. However, they have been shown this way to emphasise the balance between combat and combat support air operations. In Operation IRAQI FREEDOM 66% of offensive sorties were devoted to supporting the Land and Special Forces Component Commanders, and whilst that figure was 72% for Operation DESERT STORM, the conflicts were very different with the latter having a fairly short ground war in extensive precursor interdiction campaign. What is not clear from the above statistics, however, because both offensive and defensive sorties were considered in the counter air category, is what the breakdown between them was. With only 56 single-role fighters[55] the coalition could generate about 70 sorties per day, at the average sortie rate. When compared with the average number of OCA targets attacked per day this gives an approximate OCA/DCA ratio of 1:1. However, once it became apparent that there was no air threat swing-role aircraft such as the F15E were placed in the on-call 'stacks' with both air-to-air and air-to-ground weapons on board. These on-call missions were designated as X-AI and X-CAS etc to differentiate them from pre-planned ones[56]. Apart from the lack of an air threat, the critical factor in keeping the 'stacks' manned was the availability of air refuelling tankers[57].

The best measure of the tempo of the Operation, the points at which objectives shifted, can be seen in the following graph which shows the cumulative usage of sea and air-launched Cruise missiles and of other PGMs[58].



Cruise missile usage peaked on A Day, 21 March 2003, when over 500 were used against regime and IADs targets in the Baghdad area. PGM usage rates slowly crept up between 23 and 31 March to 1000 per day and then doubled to 2,000 per day as attacks intensified on the Republican Guard divisions defending Baghdad between 1-3 April. The rate then dropped as the focus became airborne CAS in the Baghdad area. The last summary of cumulative weapon usage was given in the DoD briefing on Monday 7 April[59], and marks the end of the intensive air campaign, relatively low weapons usage taking place for the final 12 days.

What we are seeing, therefore, is an air campaign with four main elements: firstly counter-regime and WMD targets, which would have been classed as 'strategic' targets during Operation DESERT STORM; then counter-air operations; shaping operations; and finally direct and indirect support to the Land Component Commander. This, however, was not a sequential campaign, offensive air power being employed against all of these objectives with differing emphasis at differing stages of the campaign. The only really sequential elements were the initial attacks on the Baghdad Super MEZ

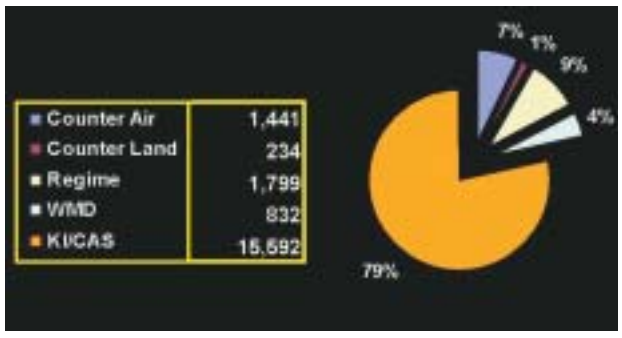
The counter-air war was, however, completely one-sided as the Iraqi air force chose not to participate. After the war MiG 25s and SU25s were found buried in the desert outside Iraqi air bases

and on the Republican Guard Divisions around Baghdad with the aims of enabling subsequent air and land operations respectively.

Whilst there is no sortie breakdown for the combat support air ops sorties, the following statistics give some idea of the weight of effort: there were over 2,200 air transport missions within the theatre, 136 MEDEVAC missions and 554 Paratroops were dropped; 417 million lbs of jet fuel were offloaded by tankers. The in-theatre airlift was critical to the successful operations from FOBs seized during the advance on Baghdad. The air component played an integral part in the theatre information campaign, dropping nearly 32 million leaflets from aircraft as diverse as the B52 and the A10. The Commando Solo variant of the C130 flew 58 sorties and broadcast over 300 hours each of radio and TV, whilst the Compass Call variant, although primarily for electronic attack, was also involved in PSYOPs[60]. In addition to that, 116 C4I targets, including 10 media facilities, were attacked as part of the information warfare plan. Finally, this was the first time the CFAC was designated Space Coordinator; in addition to the now excepted communications, reconnaissance, navigation and weather functions, space-based systems also detected 26 Iraqi ground-to-ground missile launchers. This was also the first occasion in which a UAV was integrated into the targeting chain[61], but it is clear from various US divisional After Action Reports[62] that whilst they were of enormous use at Divisional level and below, their availability was by no means guaranteed.

'By the Numbers' states that there were seven manned coalition aircraft losses due to enemy fire — 4 Longbow Apaches, 2 Cobra and one A10, and 13 other losses, whereas it is likely that an F15E and a UH60 helicopter were also lost to ground fire[63]. However, of the non-combat losses, 1 RAF Tornado GR4 and a US Navy F18 were lost to Patriot SAMs and in another incident an F16CJ fired a anti-radiation missile at a Patriot that had engaged it on 24 March[64]. In response to these losses, 55 search and rescue missions were executed. The counter-air war was, however, completely one-sided as the Iraqi air force chose not to participate. After the war MiG 25s and SU25s were found buried in the desert outside Iraqi air bases[65].

The following graph shows the relative weight of effort in terms of DMPIs struck by operation objective, given to the various elements of the air campaign[66].



When comparing the two conflicts it should be noted that in Operation DESERT STORM regime suppression and counter weapons of mass destruction targets would have been classified as strategic targets. But what stands out is that, in addition to the 234 fixed AI targets, 79% of the targets attacked were to support the Land and Special Operations Forces Component Commanders, taking 65% of the sortie apportionment.

These last two tables compare the weapons utilisation and sorties flown for the 5 major post-Cold War conflicts in which US and UK air power have been involved[67].

Date	PGM	TLAM (Cum)	ALCM (Cum)	Total
19-Mar-03	0	40	0	40
20-Mar-03	2	70	0	70
21-Mar-03	700	574	129	703
27-Mar-03	5,000	650	146	796
28-Mar-03	6,000	675	151	826
30-Mar-03	8,000	700	157	857
31-mar-03	9,000	700	157	857
01-Apr-03	10,000	700	157	857
02-Apr-03	12,000	725	163	888
03-Apr-03	14,000	750	168	918
06-Apr-03	18,000	750	168	918
16-Apr-03	18,960	800	180	980
18-Apr-03	18,965	802	180	982

DMPIs by Op Cat	Qty
Counter Air	1,441
Counter land	234
Regime Chg	1,799
WMD	832
KI/CAS	15,592

Note: 985 Cruise Missiles were fired during Operation IRAQI FREEDOM

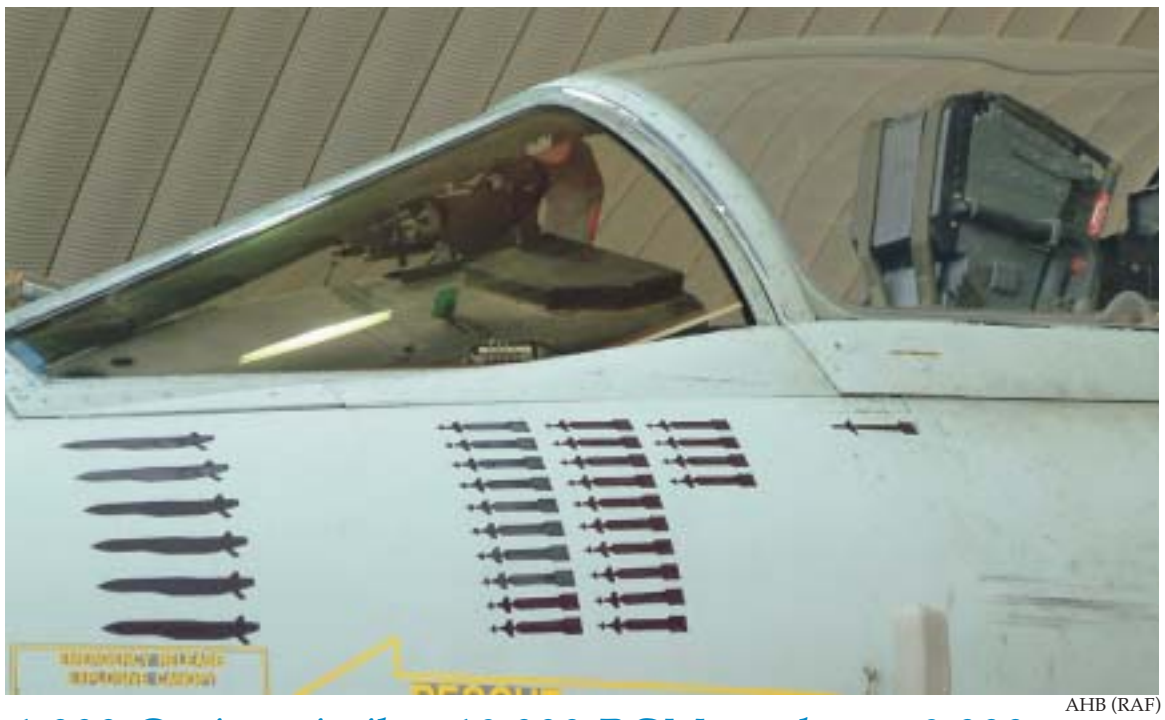
Category	%
Air & Space Supremacy	7
Spt to CLFLCC	26
Regime Chg	5
WMD	5
Spt to CFSOCC	7
CSAO	50

Note: During the intensive combat phase of Operation IRAQI FREEDOM which lasted 21 days, the average offensive sortie rate during that period was >1000/day and taking account of the inclusion of DCA aircraft in the statistics offensive sorties were about 48% of the total.

Ignoring Operation DELIBERATE FORCE, which is statistically insignificant, what stands out in both proportional and absolute terms is the steady increase in the use of precision weapons from Operation DESERT STORM to Operation IRAQI FREEDOM. However, IRAQI FREEDOM took less than half the time that DESERT STORM did and there was an increase in the overall proportion of offensive sorties in the latter conflict compared to the former.

So what then are the key issues that emerge, particularly in comparing Operation IRAQI FREEDOM with those preceding it back to Operation DESERT STORM? The first is what many people see as the rightful return of the air/land battle to its place at centre stage. The main element of the air/land campaign, from G Day to the fall of Baghdad, was only 18 days long. Two significant problems in providing air support to land operations are how to respond quickly enough to the land commanders request to attack targets in his 'deep' area, and how to provide effective and timely close air support to troops in contact without there being both air-to-ground and ground-to-air fratricide. For many decades the primary co-ordination mechanism has been the Fire Support Co-ordination Line, or FSCL, inside of which all targeting is the responsibility of the Land Component Commander and outside of which is the responsibility of the Air Component Commander. This was all very well in the Central Region of the 1970s where the FSCL was placed not that far beyond the range of tube artillery and was in preference on a prominent geographic feature due to the relatively rudimentary aircraft navigation systems of the time. However, with the advent of attack helicopters, the extended range Multiple Rocket Launcher System (MLRS) and the US Army Tactical Missile System (ATACMS) with a range of up to 100 nautical miles, the problem emerged of overlap between land and air systems. During Operation DESERT STORM, General Schwartzkopf was criticised for setting the FSCL too deep during the '100 Hour' land war which reduced the ability of fixed wing air to attack Iraqi land force targets. However, that has to be seen in the context of the communications and surveillance systems of the time. In Operation IRAQI FREEDOM General Franks planned to integrate the 'Joint Fires' of all the Component Commanders by employing a deep FSCL at or beyond the range of ATACMS[68]. The FSCL was also thrown around Baghdad as soon as ground troops commenced their final advance towards it. This, plus the speed of advance of the land forces, could have created significant problems for the CFACC and led to considerable friction. However, by embedding a 2-star airman, Major General Dan Leaf, with a large supporting staff, in the headquarters of the CFLCC, Lieutenant General David McKiernan, the CFACC, Lieutenant General Buzz Moseley, was clearly seeking to ameliorate the problems of friction, electronically integrating the headquarters as far as was possible. Of course, the benefits were two sided. CFLCC had the best chance of getting the air support he wanted, the CFACC could deal with non air support related targets and fly ISTAR and other support missions etc within the FSCL, again with the minimum of fuss[69]. Indeed the extended FSCL seemed to define far better the extended CFLCC's operational boundary than the line defining where target responsibilities lay between him and the CFACC.

One of the requirements of operating aircraft within the FSCL is that they are procedurally or actively controlled to prevent fratricide. Given the



AHB (RAF)

1,000 Cruise missiles, 19,000 PGMs and over 9,000 unguided munitions were dropped by aircraft

number of DMPIs quoted earlier, it would clearly be impossible to provide forward air controllers for every target within the boundary of the FSCL so another solution had to be arrived at, and that was the use of kill boxes[70]. A series of boxes, 30 min of latitude by 30 min of longitude, were set up inside the FSCL, which itself was being moved rapidly northwards with the ground force advance. When individual boxes were 'open' CFACC assets could attack targets within them without reference to the CFLCC, although he may well have initiated the targeting within that kill box. The boxes were declared closed by the CFLCC when his assets were either moving into or firing through them. That applied equally to Attack Helicopters and ATACMS. It is worth putting ATACMS deconfliction into context in that whilst nearly 1,000 Cruise missiles, 19,000 PGMs and over 9,000 unguided munitions were dropped by aircraft, only 414 ATACMS were used[71], although being ballistic missiles there was a greater vertical as well as a horizontal deconfliction issue. Whilst, some problems still occurred when Killboxes were closed earlier, from an air perspective, than needed to be, kill box Interdiction was the primary mechanism for eliminating the Republican Guard divisions as a fighting force.

If the kill box interdiction process worked then it appears, at least from a UK perspective, that the same cannot be said of CAS. In an interview on BBC Radio 4's *Today* programme, the Shadow Defence Secretary, Bernard Jenkin, stated "Whilst air strikes came in a very timely manner, there were occasions when it would have been preferable to have close air support very quickly and it took a considerable time to arrive because the Coalition as a whole had other priorities"[72]. He went on to suggest that RAF jets should not be pooled with US planes in future conflicts but retained to provide dedicated support for the British Army. The MOD's *First Reflections* report merely comments that "The integration of close air support aircraft requires further refinement and practice"[73]. Both sides of the argument were clearly laid out by Air Marshal Burridge in his oral evidence to the House of Commons; he made the point that we needed to look again at our procedures and doctrine and consider how we

could train better, having made the point that not pooling aircraft may mean a more inefficient use of air power; however high-tempo, post-modern warfare may just mean such aircraft ought to be a Corps level asset[74]. The GOC 1 (UK) Armoured Division, General Robin Brims, put the record straight at a recent Operation TELIC Study Day at the Joint Services Command and Staff College[75]. He firstly pointed out that , because 1 (UK) Armoured Division was directly subordinate to the 1st Marine Expeditionary Force, its CAS was provided through the US Marine Corps system by the 3rd Marine Air Wing (MAW) which was not a part of the Air Component. Furthermore US Marine ANGLICO sections were attached to all UK formations down to Battle Group level to provide their linkage to 3 MAW. In answer to a question as to why 7 Brigade had had no CAS for a week, he made the point that the Brigade was getting CAS, that "a week" was something of an exaggeration, that in the event in question the allocated CAS had been diverted quite correctly at the last minute to other troops in contact with a more urgent requirement, and concluded by saying that the commander "had to use his own guns instead".

The US Marine Corps analysis[76] was very different in that combat operations validated their quick fire procedures as a baseline TTP. Variations were introduced or improvised as required to adapt to conditions on the battlefield and it proved to be an effective way to employ Marine air in a reactive counter-fire role. With a direct air support centre providing the link between targeting assets at Division and below, it is clear that CAS was being run at Corps level and that within the FSCL there were two discrete sets of AI/CAS airspace, one for 1 MEF and the other for 5 (US) Corps. However, as the Commander US Marine Corps Forces Central Command, Lieutenant General Earl B Haylstone[77], said there was constant liaison between headquarters at all levels, including substantial British liaison elements in all Marine headquarters in addition to there always being an Air Force officer in them. In the CFACC's headquarters, all close air support "was headed up and planned by a Marine". The Joint Fires integration procedure was such that in the initial operation to seize the Al Faw Peninsula, in addition to air support, two Royal Navy frigates provided naval gunfire support[78]. The US Army was particularly enthusiastic about the effectiveness of the CAS it received, where it was assessed as one of the "winners" at their 2003 All Infantry Conference. The Corps level of the co-ordination of the joint targeting and fire support process worked well. Precision CAS was very effective in an urban environment; no more training was needed at lower echelons to improve this capability. AI/CAS techniques worked well and the size of the Corps rear area was such that CAS needed to be used for rear area fires as well as in support of the front echelons. The airspace was easily deconflicted, allowing simultaneous engagements and allowing the Divisional ALO to position "CAS stacks " thus reducing response times[79]. CAS was delivered by everything, from the B52 to the A10 and, whilst JDAMs were very effective, they required longer lead time than traditional CAS systems. However, the point was made that aerially delivered fires were an extremely powerful asset but external factors often kept them from the fight.

From the USAF perspective[80], the success of Killbox Interdiction and CAS (KI/CAS), and Urban CAS in particular, was down to the detailed plan put together by a joint team headed by a USMC Major. But the number of assets available to the CFACC also played a significant part in this. Gen Moseley commented that the CAS stacks could contain mixed assets from the USAF, USMC, US Navy, RAF and RAAF and that they could be put in place 24 hours per day, with aircraft returning with their bombs if their particular weapons load was not required. Whilst that appeared to be wasteful he further commented that "What we are looking for here is combat effectiveness, not necessarily combat efficiency"[81].

At the operational level it is worth comparing the air command and control structure of Operation IRAQI FREEDOM with that of Operation DESERT STORM. In the latter conflict a 43-day air campaign focused on strategic target sets and on shaping the battlefield for the culminating four-day ground campaign. The vast majority of offensive air targeting was therefore managed through the Air Tasking Order (ATO), as the majority of the targets were pre-planned and, until the last

100 hours, there was no FSCL to deconflict with. Because of the need for continuing SEAD and the relatively large numbers of aircraft needed, particularly for airfield targets, packages were put together from multiple bases and the ATO needed to be at those bases at least 12 hours before the combat cycle commenced to enable mission planning and co-ordination. This then fell in naturally with a 72-hour planning cycle which started with determining the Master Attack Plan (MAP) for the day in question. The system, however, was not as inflexible as many commentators point out, with the 'current' ATO being handled by combat ops. However, because of the pre-planned and finite timescales of the air campaign, the easiest response to the failure of a large mission for whatever reason was to cancel and reschedule. However it was possible to retarget or reschedule missions through combat ops at very short notice[82]. Furthermore, in the Kuwait theatre of operations, and in Iraq once the land campaign had commenced, there was significant CAS and battlefield air interdiction managed on a kill box basis with tanker supported CAS stacks being managed by an Airborne Battlefield Command and Control Centre.

In contrast, as has already been seen, the balance was completely reversed for Operation IRAQI FREEDOM with the vast majority of targeting being managed on a responsive basis. The ATO therefore changed from being primarily a targeting tool to being a resourcing tool where the critical path became the provision of air tanking resources, and then ensuring that crews and aircraft of all roles were available throughout the 24 hours period to be available in the air to meet the reactive tasking[83]. Because of the serious consequences of the use of Weapons of Mass Destruction (WMD), and the fleeting nature of some targets, a capability was developed by Commander US CENTCOM and the CFACC to find, fix, track, target, engage and assess these time-sensitive targets. In all 156 TSTs were attacked, 102 being related to WMD, 50 to Iraqi leadership and four to terrorist related targets. However, in addition to these, a further 686 'dynamic targets' were prosecuted using the same command and control mechanisms through re-targeting airborne aircraft[84]. This flexibility was made possible, as General Franks makes clear, by the development of a joint culture in the headquarters and by, for the first time, the integration rather than deconfliction of forces. He went on to say that the Blue Force Tracking and enhanced C4I systems greatly increased lethality and decreased response times. However, producing an integrated common operating procedure required workrounds because different tracking systems were service unique[85]. However, whilst there was a significant amount of 'data-suck' into the component and theatre headquarters, it was from systems such as Blue Force Tracker which were not available in the cockpits of attack aircraft.

If the 72-hour ATO cycle was swiftly adapted to be a resourcing rather than a targeting tool, the same was not always the case for land forces. The 1st Marine Division identified the fact that the planning to execution cycle, for AI, was too long and not responsive to changes in the scheme of manoeuvre. The result was that AI shaping efforts often did not focus on the enemy forces that 1 MEF would fight 48 hours hence. This was exacerbated by the speed with which the Division executed their scheme of manoeuvre[86]. 1 MID also identified in their 'Lessons Learned' that "there was no reliable and responsive process or means to determine whether AI targets on the prioritised target list were serviced and successfully attacked during and after ATO execution" [87]. One reason for this failure was that the tempo of the operation and the speed of advance by the land forces was such that the traditional intelligence analysis of photographic and other reconnaissance products could not keep up. Another reason is perhaps that the traditional BDA concept itself was no longer appropriate to a campaign planned according to an effects-based methodology.

Before seeking to answer this question it is worth examining what is meant by effects-based operations. The term effects-based operations, or EBO, occurs throughout the primary source material upon which this article has been based. In a briefing on that subject[88], Colonel Gary Crowder made the point that EBO was a different way of thinking about how we approach military planning by starting from the policy objectives rather than from the list of available targets. General John Jumper,

As with Operation DESERT STORM, the coalition indicated it was willing to take significant casualties by the provision of significant MEDEVAC facilities and, among other things, an 800-bed hospital ship. In the end, coalition combat casualties were remarkably low

US Air Force Chief of Staff, took a similar view[89], where he stated that "The USAF's emphasis on effects-based operations as opposed to fighting a war of attrition allowed it to employ platforms like the B1B strategic bomber in non-traditional ways to provide close air support". He then went on to say, "We are still not satisfied with bomb damage assessment. This gets into how we define bomb damage assessments. At the one level you need to know how the killing of targets is having a strategic outcome. This is what tends to be done by our intelligence agencies, they have very specific definitions of what is destroyed. It is the product of overhead imagery analysis that gets into these precise definitions"[90]. Another statement, this time by General Brookes, again linked effects to battle damage assessment (BDA) and image analysis, "They take a close look. Did we achieve the desired effect? Did all of our weapons hit?"[91]. From the UK perspective, an MOD report[92] states that "All targets were derived from the campaign plan and were selected to achieve a particular military effect such as the degradation of Iraqi command and control systems". However, Air Marshal Burridge's view[93] was that the "strategy to task" methodology provided an audit trail which linked the attacking of any specific target, or by inference any other activity within the air campaign, to the production of a specific operational and then strategic outcome.

In his article in the Autumn 2003 edition of the Air Power Review, Colonel Phil Meilinger quotes 2 definitions of EBO[94]. US Joint Forces Command definition is *"a set of actions planned, executed and assessed with a systems perspective that considers the effects needed to achieve policy aims via the integrated application of various instruments of power"*. The second unofficial definition from a RAND analyst, *"Effects-based operations are operations conceived and planned in a systems framework that considers the full range of direct, indirect and cascading effects which may – with differing degrees of probability – be achieved by the application of military, diplomatic, psychological and economic instruments"*[95]. From a military perspective one could therefore conclude that at the operational level, that level at which campaigns are planned and executed, the operative phrases are: policy objective, systems framework and direct, indirect and cascading effects. Whilst the definitions of effects-based operations are clearly strategic, a concept that could simply be described as 'decide the outcome before allocating the best mechanism, then have a plan that envisages alternatives and can cope with the unexpected', is applicable at the strategic, operational and tactical levels of war. It is here that the confusion arises. The above quotes from Generals Jumper and Brookes both exhibit this mixing of levels, and both state that strategic effect is immediately measurable in tactical outcome, ie what has been destroyed. This, Meilinger argues, is to completely misunderstand the concept of effects-based operations and that what is needed at the strategic level is a set of Measures of Effectiveness that reflect the desired strategic end state. The same is true at the operational level. In fact EBO is very similar to the well-established UK concepts of the Manoeuvrist Approach and the linked role of Mission Analysis as the start of any military planning process. Furthermore, as Meilinger repeatedly points out in his article, airmen have always understood the concept of EBO, but it is only now that technology, in the form of precision weapons and information systems, has enabled us to achieve it.

This then seems to indicate the true nature of the problems with the BDA process, in that it was predicted on measuring the physical outcome of destructive sorties, ie the tactical effect, whereas the commanders and the campaign planners were looking for assurance that operational and strategic effects were being achieved. Finally, none of the discussions outlined above addressed the measurement of non-kinetic effects, ie information warfare or the effect of coercive bombing, at any of the levels of war. When considered with the realities of high-tempo precision warfare it may therefore be better to quite simply assume that

In defeating Iraq in just 21 days of intensive combat, control of the air was essential. Without it the air assets would not have been able to operate with almost complete freedom

precision weapons will on, say, 90% of occasions achieve the destructive effect they are supposed to and then concentrate on assessing an enemy's behaviour, particularly at the operational level and above. This is not to suggest that imagery-based intelligence is redundant, far from it; it has a particular value in providing evidence to rebut collateral damage claims. But rather it would allow those assets to be concentrated more on time-sensitive and dynamic targeting and on strategic and operational analysis of the results.

Before seeking to draw some lessons from the analysis of this conflict, it is worth stating one caveat, particularly when comparing it to the other major post-Cold War campaigns. That caveat is the overwhelming military dominance that the coalition forces displayed. There was no doubt in the minds of either the coalition politicians or military planners that the end result would be anything other than a decisive victory. And, as with Operation DESERT STORM, the coalition indicated it was willing to take significant casualties by the provision of significant MEDEVAC facilities and, among other things, an 800-bed hospital ship. In the end, coalition combat casualties were remarkably low. That is due, in no small part, to the short duration of the combat phase itself. The coalition was also hugely dominant in terms of air power; roughly the same number of aircraft were employed as was in Operation DESERT STORM. Capabilities, particularly in terms of precision weapons and ISR, were significantly greater in Operation IRAQI FREEDOM. Furthermore, the Iraqi Air Force had not developed at all over the preceding 12 years and had had very limited opportunities to maintain their operational capability. Except in the No-Fly Zone gap from 33° to 36° North, the Iraqi air defence system had been steadily attrited by Operations NORTHERN and SOUTHERN WATCH, thus enabling the air and ground campaigns to coincide.

Air power can still be employed autonomously, both to achieve operational and strategic effects, as was in the case of regime and WMD targets, and in achieving and sustaining the required degree of control of the air across the theatre

So, what are the lessons we can draw from Op IRAQI FREEDOM? The first lesson to emerge is that of the continuing criticality of control of the air in modern warfare. In defeating Iraq in just 21 days of intensive combat, control of the air was essential. Without it the air assets would not have been able to operate with almost complete freedom throughout Iraq and land forces would not have had the shaping and supporting operations that they did. Furthermore, the land forces would not, with the exception of maintaining a defence against theatre ballistic missiles, have otherwise been able to conduct their operations without having to integrate their own defensive counter-air assets with those of the CFACC and with their own manoeuvre. However, as more modern surface-to-air missile and fighter systems are proliferating throughout the world it is highly unlikely that future major conflicts will be fought in such a relatively benign environment as Iraq as far as control of the air is concerned.

The next lesson as far as the application of air power is concerned is the blindingly obvious one of the value of overwhelming information superiority. Not just to enable flexible and responsive targeting but also to seize opportunities and conduct high tempo operations that far exceed the enemy's ability to respond. However, this reliance on information superiority does create its own vulnerabilities, for example when the Iraqis started using irregular and often illegal combatants, such as soldiers in civilian clothes, particularly in the rear areas.

The next lesson concerns the land-air interface. The first observation is that this was most definitely a non-linear battlespace. Discrete air and land operations took place in the north and the west of Iraq with 2 Corps operating on different axes initially, one towards Basra and one towards Baghdad, with the Marine elements of the Basra axis then swinging towards Baghdad as well. But whilst the FSCLs were not straight, and they were very fluid, the co-ordination between air and ground forces was still defined in terms of geographical co-ordinates, altitude and time. Furthermore, the nature of the sorties conducted in support of the CFLCC could still be characterised in terms of; direct support to troops in contact, attacks to shape the CFLCC's deep battle over the next 48 hours or so, and attacks to shape land operations within the theatre as a whole. In other words, CAS, BAI and AI respectively. Whilst the terminology could be said not to matter, because aircraft were repeatedly interchanged between targets in these 3 categories and indeed into the TST ones, there is a purpose in defining the tactical level effect the CFACC is seeking to achieve either on behalf of the CFLCC or the Theatre Commander. However, one lesson that the RAF and the British Army must take from Operation IRAQI FREEDOM is that KI/CAS procedures not only need to be developed further, and the concepts jointly understood, but they should also be exercised regularly at all levels of the command chain as well as at unit level.

However, despite the resurgence of land-air operations, air power can still be employed autonomously, both to achieve operational and strategic effects, as was in the case of regime and WMD targets, and in achieving and sustaining the required degree of control of the air across the theatre.

As with Operation ENDURING FREEDOM, the value of air refuelling cannot be overstated in the expeditionary context. Air refuelling was the major factor in determining fast jet sortie rates and enabled the 'on call' delivery of offensive air power which was essential to Commander CENTCOM's scheme of manoeuvre.

The requirement to be able to deploy and sustain the force is equally obvious. In this campaign a similar sized force to that used by the UK during Operation DESERT STORM was deployed in half the time. Access, basing and over-flight, particularly after the closure of the Turkish option, required the support of many other nations, in particular our established friends in the Gulf

Despite their relatively low profile, the air power operations appear to have been the key to the rapid degradation of Iraqi defences, and hence the relative ease with which the ground troops took over the country

region. However, asset-tracking was poor[96]. Furthermore, the move to reduced war stocks and "just in time delivery" implied a high degree of operational risk[97]. Manpower, particularly that in specialist and undermanned trades, was also a resource that needed to be carefully husbanded and managed.

Five RAF Regiment squadrons and three tactical survive-to-operate wings were deployed for force protection of RAF assets during Operation IRAQI FREEDOM. Whilst WMD were not, in the event, used against coalition forces and there were no suicide bomber or other terrorist type attacks reported on air bases in theatre, the possibility of such attacks cannot be excluded when planning for future conflicts.

The reliance of UK forces on space-based assets for communications, reconnaissance, environmental data and, in particular, navigation and targeting, is such that it now merits consideration in terms of British strategic air power doctrine as a core enabling capability on a par with sustainability and force protection.

Although an effects-based campaign could be conducted without the benefit of a networked C4 ISR system, and vice versa, the air aspects in particular of Operation IRAQI FREEDOM highlighted their mutual benefits. However, in Operation IRAQI FREEDOM there was more a one-way data flow with high fidelity tactical information being available in the greatest detail at the highest headquarters, but not being disseminated down to individual combatant units. Effects-based operations is really a strategic concept, with some operational application, with the concept of strategy-to-task linking it to the various tactical mechanisms that can be employed, be they kinetic

or non-kinetic. Furthermore, the language of effects-based operations is generally very loosely applied with little understanding as to its true meaning. Net-centric warfare, to use the latest variation on its title, has universal application. Employment of the two concepts together enabled a campaign that was characterised by its integrated nature and high tempo. However the high tempo of operations, and the lack of a universally available common operational picture, may have contributed to some incidents of fratricide between coalition forces.

The last lesson concerns US/UK compatibility. As it is most unlikely that the UK will ever fight another major campaign of the nature of Operation IRAQI FREEDOM except as a coalition partner with the United States of America, increasing our compatibility in terms of both equipment and doctrine is essential. That is not to say that we should just adopt their higher level concepts and doctrine, there are sound cultural and structural reasons for not doing so. But we need to develop an understanding, particularly in our middle ranking officers, of our shared concepts for the employment of air power to enable them to understand the context of any combined operations and headquarters in which they may find themselves involved.

In conclusion, Secretary of Defense Rumsfeld has identified[98] the key lessons of Operation IRAQI FREEDOM as: Speed, Jointness, Intelligence and Precision. All these characteristics have been seen to a greater or lesser extent in all the post-Cold War conflicts that involved the significant use of air power. However, the decisive role that airpower played in Operation IRAQI FREEDOM has not been widely recognized. As Timothy Garden observed " despite their relatively low profile, the air power operations appear to have been the key to the rapid degradation of Iraqi defences, and hence the relative ease with which the ground troops took over the country."[99]

Operation IRAQI FREEDOM has given us an insight into a future battlespace in which air, land and maritime forces become less and less deconflicted and more and more integrated. However, the level of integration varied not only across the Components, but also across their component parts. Levels of communications, data links and concomitant flexibility of operations varied between the divisions. The same was true of individual air platforms, particularly in the provision of tactical data-links, but the CFACC did have the benefit of a much flatter, de-layered command and control structure than his land counterpart. The electronic linkage of the CENTCOM and Component Command Headquarters in particular, perhaps, point to a future construct where, whilst continuing to be environmental resource providers, component commanders may no longer function as individual tactical commanders, but rather as the environmental experts within an entirely integrated planning and operational process. The concepts of the core capabilities of air power still appear valid. However, the active capabilities, what air power can deliver: information exploitation, control of the air, strategic effect, direct and indirect support operations and combat support air operations will be better expressed in terms of the effect they can achieve. Force protection, sustainability and, in the future, space, are the enablers of those effects. However, what has changed and is continuing to change are the technologies, particularly for command and control or weapon delivery, and the attendant campaign planning and implementation philosophies.

But whilst our methods of waging war are constantly developing, some concepts are enduring. The quotation from General Ulysses S Grant that headed this article is a very good description of modern, high tempo, precision and networked air warfare. Airmen need to understand not only the technological aspects but also the underpinning concepts and history if they are to apply air power effectively and flexibly in the future.

Notes:

1 Extract from the Motion debated in the House of Commons on 18 March 2003, cited in House of Commons Research Paper 03/50 *The conflict in Iraq* 23 May 2003 p12.

2 DoD News Briefing – Secretary Rumsfeld and General Franks, May 9 2003.

3 Statement to the House of Commons – Secretary of State for Defence, 20 March 2003.

4 DoD News Briefing – Secretary Rumsfeld and General Myers, 20 March 2003.

[5] DoD News Briefing – Secretary Rumsfeld and General Myers, 21 March 2003.
[6] Ibid.
[7] HQ US CENTCOM News Release No 03–03–44, 22 March 2003.
[8] Defence Secretary and Chief of Defence Staff Press Conference at the Ministry of Defence, London, 22 March 2003.
[9] HQ US CENTCOM News Release No 03–03–59, 24 March 2003.
[10] American Forces Press Service 25 March 2003 quoted in House of Commons Research Paper 03/50, 23 May 2003.
[11] CENTCOM Operation IRAQI FREEDOM briefing, 25 March 2003.
[12] Jane's Defence Weekly interview, 3 September 2003, p 32.
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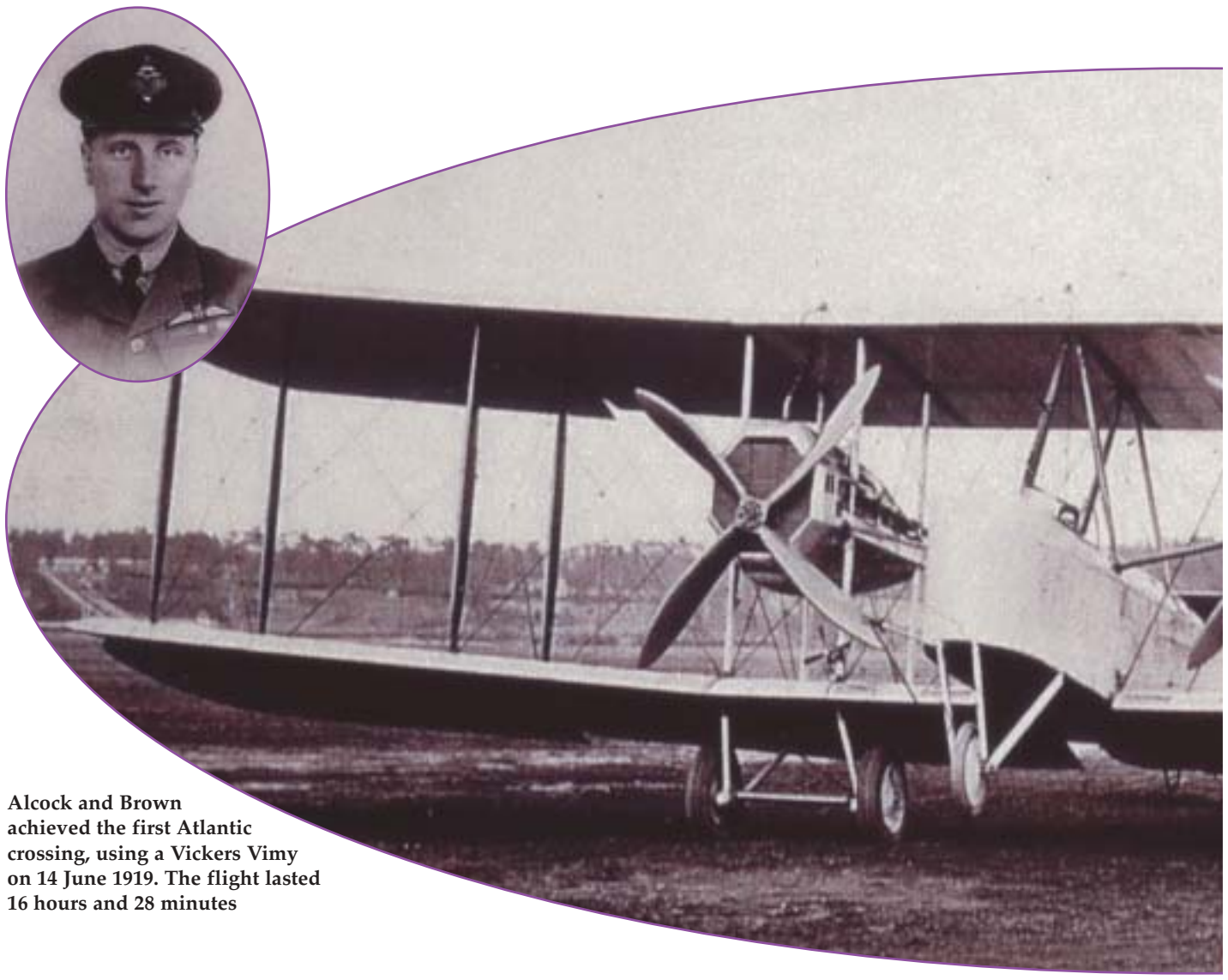
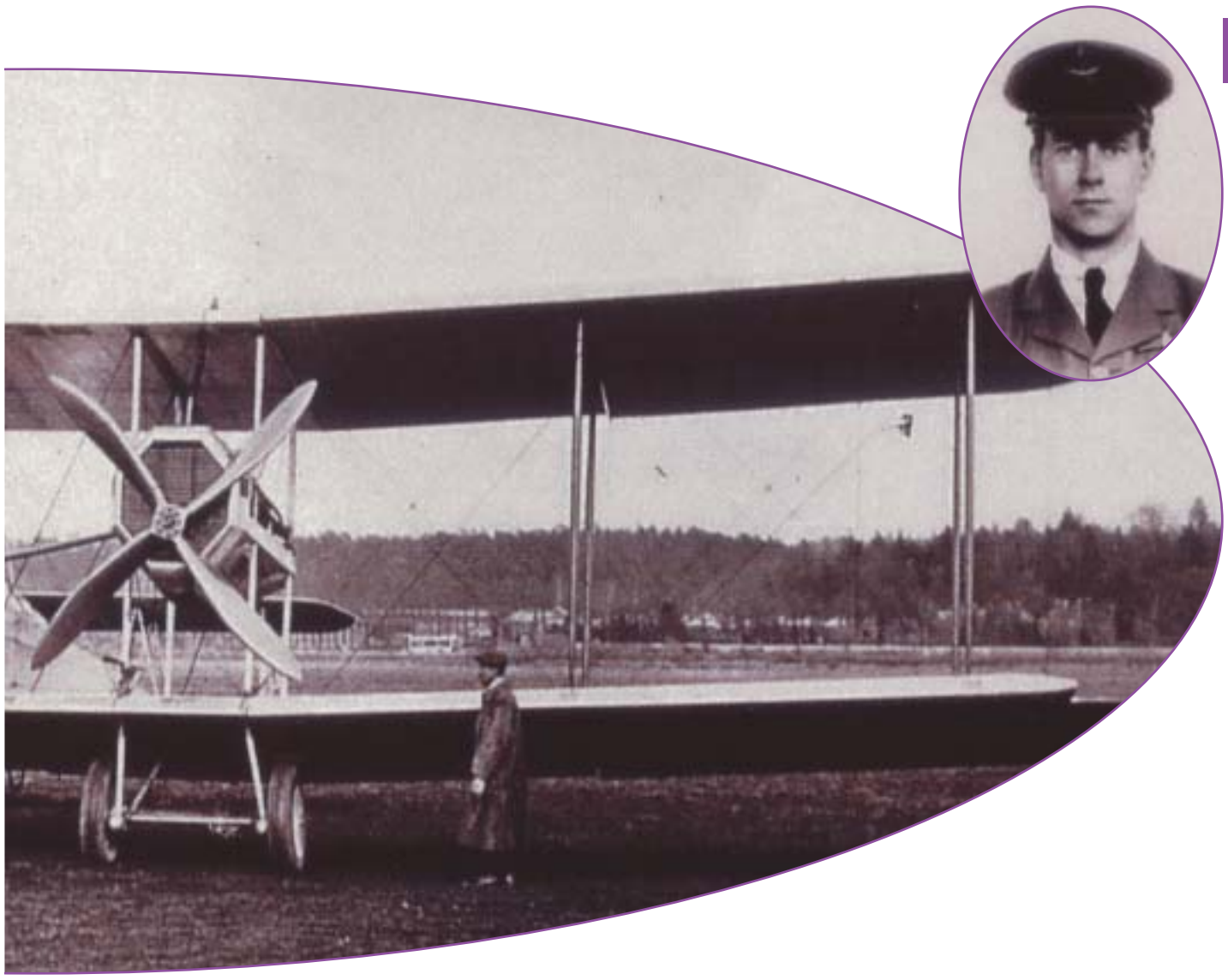


Alcock and Brown achieved the first Atlantic crossing, using a Vickers Vimy on 14 June 1919. The flight lasted 16 hours and 28 minutes

100 Years of Powered Flight

A Human Perspective



By Air Marshal ‘Black’ Robertson

The time will come when thou shalt lift thine eyes
To watch a long-drawn battle in the skies.
While aged peasants, too amazed for words,
Stare at the flying fleets of wondrous birds.

England, so long mistress of the sea,
Where winds and waves confess her sovereignty,
Her ancient triumphs yet on high shall bear
And reign the sovereign of the conquered air.

(Thomas Gray, 1716-1771)

Thomas Gray’s words, written in 1737, were remarkably prescient. While England may not have reigned sovereign she has certainly seen some remarkable developments in the story of flight. This treatise picks out some of the key moments in British aviation in the last 100 years or so — from the well known to events that are much less familiar. In so doing it concentrates on just a few of the people who contributed to the inspiring story of flight and, in particular, it examines some of the qualities they exhibited. The history of

Paulhan was better able to cope with such weather and landed in Manchester in another Farman biplane in the early morning, earning £10,000 for his 186-mile journey

Louis Paulhan

powered flight is as much a human story as it is a technical one. Man's prodigious progress owes a great deal to the characteristics of enterprise, ingenuity, vision, tenacity and courage exhibited by the pioneers of aviation. Thus if there is a theme that runs through these paragraphs it is one that reflects the nobility of the human spirit.

The starting point is three contests with unique and specific rules, organised by the *London Daily Mail* in the early 1900s. The pioneers of British aviation owed much to the generosity of this newspaper's founder, Alfred, Lord Northcliffe. The first prize, of £10,000 for a flight from London to Manchester, was offered in November 1906. The journey had to be completed in 24 hours with no more than two stops *en route*. At the time the Daily Mail's money seemed safe — so much so that Punch, the satirical magazine, offered a similar sum for the first man to swim the Atlantic and for the first flight to Mars and back within a week!

Such was the pace of progress that by 1910 two competitors were ready to vie for what was in those days a substantial prize: Claude Grahame-White and a Frenchman, Louis Paulhan. The Englishman set off first on 23 April, having persuaded the London & North Western Railway to whitewash the sleepers for 100 yards or so north of every junction so that he could be sure of his route. But gusty winds in the Trent Valley forced him down just over 100 miles into his flight. Overnight these same winds overturned his Farman biplane in the field where it was left untethered and it had to be returned to London for repairs. Four days later Paulhan seized his chance and began his own journey from Hendon. When Grahame-White heard this he set off again in pursuit from Wormwood Scrubs in his restored machine late that same afternoon. However, failing light forced him to put down in a field when he was still some miles behind his rival. His only chance of catching Paulhan, who by dusk was still short of Birmingham, was to fly by night — which at the time was virtually unprecedented. Undeterred by the obvious dangers he set off again just before 3 am the next morning. The field was lit by lamps at either end and his friends set out to guide him using fast cars with powerful lights and huge flares at appropriate railway stations. By daybreak Grahame-White had almost overhauled the Frenchman. However, he ran into

Contestants had to fly British aircraft fitted with British engines. This was because at the time British aeroplane and engine constructors lagged behind their French counterparts

more bad luck in the shape of a faltering engine and strong winds that once again forced down his flimsy craft, effectively removing any chance of victory. The more experienced Paulhan was better able to cope with such weather and landed in Manchester in his own Farman biplane in the early morning, earning £10,000 for his 186-mile journey.

The second *Daily Mail* £10,000 prize, for a 'Circuit of Britain' flight, was offered a month later, in May 1910. The rules this time meant covering roughly 1,000 miles in a week, stopping at 11 fixed control points including Edinburgh, Glasgow, Bristol and Exeter; London was the start/finish point. Such was the rapid progress in aviation that 30 competitors registered to enter. The race itself began on 22 July the following year. After the first 20-mile stage — essentially a spectator event from Brooklands to Hendon — there were only 17 competitors left. In these early days reliability was something of a problem of course! Engine difficulties and a variety of other breakdowns soon further reduced the original competitors to two — both Frenchmen. Victory finally went to a naval officer, Lieutenant Jean Conneau, in a time of 22 hours and 28 minutes — an average of about 45 mph. His success was attributed largely to his naval training and map reading. His rival, Jules Védrines, apparently lost his way two or three times over what was to him unfamiliar terrain.

In the time-honoured British tradition of rewarding glorious failure, and recognising the enthusiasm for flying — the Daily Mail *generously presented Hawker with a consolation prize of £1,000*

This is not to belittle Védrines' achievements. He was one of the most successful air race pilots of the period and the first to exceed the 100 mph barrier, setting a record of 104 mph in 1912. There are interesting footnotes to Conneau's achievement too. He is credited with developing what became known as the 'dead reckoning' method of airborne navigation. The records also show that he invariably competed as André Beaumont. This fooled no one but was necessary because at the time the French Navy considered sport flying 'an unduly frivolous activity'.

The third historic flight, this time for a 'Water-plane Flight Round Great Britain' attracted a £5,000 prize. The rules specified a counter-clockwise route from Cowes on the Isle of Wight, along the south and east coasts to Aberdeen and Cromarty, thence through the Caledonian Canal to Oban, on to Dublin, Falmouth and, finally, along the south coast again to Southampton Water. There were two other important conditions: contestants had to fly British aircraft fitted with British engines. This was because at the time British aeroplane and engine constructors lagged behind their French counterparts. In this context it would be hard to over-emphasise the significance and, indeed, the impact of Blériot's 37-minute trip from Calais to Dover on 25 July 1909 — a flight that earned him another £1,000 prize from the *Daily Mail.*

This third competition brought together two famous names in British aviation: Tommy Sopwith, the aircraft designer, and the man he chose as his pilot, Harry Hawker (an Australian). Hawker's first attempt, on 16 August 1913, ended in failure when he was affected by sunstroke at Yarmouth, having already completed 240 miles in 4 hours. There he was replaced by another Australian, Sydney Pickles. This was within the rules because the contest was a test of British engineering, not British pilots. However, Pickles' own attempt was aborted when he had to beach his seaplane in rough water at Gorleston. So Hawker restarted from Cowes at 5 o'clock on the morning of Monday 25 August 1913, carrying his mechanic as a passenger. He had to contend with haze, strong winds (particularly along the Caledonian Canal), an overheating engine, valve problems and a waterlogged float. But such was the enthusiasm generated for the new science of aviation that some 40,000 people gathered to watch Hawker arrive in Aberdeen. Two days after starting, behind schedule and no doubt tired by

26

As World War I progressed, Britain began to match the skill and courage of its pilots with world class aircraft like the Sopwith Camel and the SE5A

Sopwith Camel

AHB (RAF)

his exertions, about 15 miles north of Dublin Hawker's rubber-soled boot slipped off the rudder bar and, from a height of about 50 feet, his aircraft fell out of control into Lough Shinny. It was completely wrecked but, miraculously, he emerged unhurt; his mechanic was less fortunate and broke an arm and was badly cut. But in the time-honoured British tradition of rewarding glorious failure, and recognising the enthusiasm for flying that Hawker's exploits had generated — not to mention the extra newspaper sales — the *Daily Mail* generously presented Hawker with a consolation prize of £1,000.

There is more to be said about the importance of competition in aviation later. But first it is worth drawing an early conclusion about those human qualities referred to earlier. The pre-World War I days of aviation in Britain were marked not only by the ingenuity of engineers and the courage of their pilots; they were notable too for the vision and enterprise of those prominent in public life. Lord Northcliffe not only helped aviation to prosper, he also led the public at large to recognise that aircraft were a matter of national importance. Without its founder's encouragement, and without the *Daily Mail's* public-spirited sponsorship, which effectively extended the perceived boundaries of aviation, progress would undoubtedly have been considerably slower.

The lead-up to the First World War saw further evidence of the early technical lead the French had established in Europe. By way of illustration, in 1911 the French could muster over 200 aircraft during army manoeuvres, whereas between them the British Army and Navy could manage only 12, together with 3 airships. French influence was also evident in early British aircraft design and nomenclature: hence the BE (Blériot Experimental), the FE (Farman Experimental, after the brothers Henri and Maurice Farman), the SE (Santos Experimental, after the Brazilian, Santos-Dumont, who was the first man to fly in Europe — in France in the autumn of 1906) and the RE (Reconnaissance Experimental). However, with

establishment of the Royal Flying Corps on 13 April 1912 and similar recognition of the Royal Aircraft Factory at Farnborough, which capitalised on the nation's inherent technical expertise and industrial strength, Britain at last began to catch up with her continental rivals. Moreover, as World War I progressed Britain began to match the skill and courage of its pilots with world class aircraft like the Sopwith Camel and the SE5A. A contemporary writer on aviation was moved to observe that: *'A very striking feature of the* [Royal Flying] *Corps is the extreme youth of the members, many of the most daring fighters in the air being mere boys of 20. The Corps has the very pick of the youth and daring and enterprise of the country.'*

(William J Claxton, *The Mastery of the Air*)

The Royal Air Force itself was formed on 1 April 1918. However, its size could not be sustained in the aftermath of World War I. To highlight the nature of this problem, in November 1918 there were 27,500 officers, 264,000 other ranks and 25,000 members of the Woman's Royal Air Force. There were also more than 22,500 aircraft and about 100 airships. It was Winston Churchill, appointed Secretary State for War and Air in January 1919, who was largely responsible for the salvation of the new Service. He achieved this by inviting Hugh Trenchard back to his old position as Chief of the Air Staff. Then, in a far-sighted move, in April 1920 Trenchard opened the Royal Air Force College at Cranwell in Lincolnshire — a

They had been in the air for 16 hours and 28 minutes and had made history. When they reached London they were honoured by a reception at the Royal Aero Club and were immediately knighted. The flight of these two pioneers represents a triumph of engineering and an inspiring example of out and out courage

The Royal Aero Club borrowed heavily from existing sports, including horse racing, for its early regulations. This explains why the first air racing rules contained the injunction that 'No rider shall interfere with another rider on the course'

measure, and a training environment, that was to underpin the RAF's future. Lord Trenchard, as he later became, was to all intents and purposes the father of the Royal Air Force. He exemplified the vision that was fundamental to the development of military aviation in general and the Royal Air Force in particular.

To pick up the thread of our story again we need to go back the morning of 28 April 1910. Among the thousands who watched Paulhan land in Manchester was an 18 year-old apprentice engineer, John Alcock. By 1913 he had qualified as a pilot and had even won a race at Hendon Aerodrome. While this was just a weekend activity for Alcock at the time, later that same year his imagination was fired by a new challenge. Lord Northcliffe's newspaper was offering another £10,000 prize, this time for a flight across the Atlantic. The original rules allowed refuelling and repair *en route* and obviously favoured flying boats. But before anyone could rise to the Daily Mail's latest challenge, World War I intervened. Alcock joined the Royal Naval Air Service where he was shot down towards the end of the War while bombing the Turks. By coincidence, the man with whom he was to earn lasting fame as the first crew to complete a non-stop crossing of the Atlantic, was another prisoner of war, this time of the Germans: Arthur Whitten 'Teddy' Brown.

With the end of the War, by 1919 the prize for a transatlantic flight had grown to £13,000 through additional donations, both private and commercial. However, the rules had changed. The flight was now to be non-stop — a tremendous challenge given that the shortest distance across the Atlantic, between Newfoundland and Ireland, is some 1880 miles. The contest spawned a number of entrants and resulted in a several abortive attempts. Alcock and Brown were amongst the last to start. Their aircraft, a modified Vickers Vimy powered by Rolls-Royce Eagle engines, finally arrived in Canada in 13 wooden crates on 26 May — 16 days after Harry Hawker and his navigator had been rescued after ditching. The intrepid Australian continued his run of consolation prizes and received another £5,000 from the *Daily Mail* in recognition of his efforts. It was on 14 June that Alcock and Brown finally began their momentous journey.

To say that their flight was hazardous would be an understatement. Brown, who was partially disabled (he limped) after being shot down, was regularly forced to climb out of the cockpit to clear icing. For his part, Alcock had to cope with engine shutdowns, loss of control and the resulting near fatal loss of altitude. When they eventually reached the Irish coast Alcock saw radio masts at Clifden, a military installation, and decided to land on what looked like a smooth green field nearby. It was actually a huge bog. Men on the ground tried to wave the aircraft away but the crew merely waved back. As the aircraft touched down, its wheels dug in and it nosed over. This was partially Alcock's fault. To reduce drag he had decided against adding a nosewheel — the very feature designed to prevent the aircraft from ploughing into the ground on landing. Fortunately, both men scrambled out largely unhurt. They had been in the air for 16 hours and 28 minutes and created history. When they reached London they were honoured by a reception at the Royal Aero Club and immediately knighted. The flight of these two pioneers represented not only a triumph of engineering, it proved an inspiring example of out and out courage.

It would be hard to overstate the influence of the Royal Aero Club in the early years of the last century. In March 1910 the Club (or the RAC as it was popularly known) became responsible for the control of all private and sporting flying in the UK, as well as records and competitions (having started with the Daily Mail events), and continues to fulfil this function to this day. It borrowed heavily from existing sports, including horse racing, for its early regulations. This explains why the first air racing rules contained the injunction that: '*No rider shall interfere with another rider on the course*'. Club

The schneider Trophy was won three times consecutively by a Supermarine aircraft designed by Reginald Mitchell

AHB (RAF)

Thus it was a spirit of enterprise that contributed directly to Britain's third consecutive win in September of 1931, when Flight Lieutenant J N Boothman, flying an S6B, brought home the trophy permanently

members also included many of the most famous names in British aviation, amongst them Geoffrey de Havilland, Alex Henshaw and Alan Cobham.

On behalf of the International Aeronautical Federation the RAC also organised those Schneider Trophy Races that took place in Britain. (The Trophy rules dictated that the previous winner hosted the next race.) This competition, one of the most important international events in aviation history, was conceived by a French Government official, Jacques Schneider, in 1911; the original prize was £1,000. The rules were somewhat bizarre. Aircraft had to float for 6 hours and further prove their seaworthiness by travelling some 500 meters on water. They also had to land on water twice during the race. The actual words were *'come in contact with'*, which in 1919 led Howard Pixton to invent a bouncing manoeuvre. This effectively increased average speeds, not least by reducing the tendency for floats to take on water — a penalty in terms of all up weight. The rules also dictated that after three consecutive wins the Trophy became the permanent property of the country concerned. Britain first won the event in 1914, then again in 1922 when a Supermarine Sea Lion II flying boat designed by Reginald Mitchell set a new speed record of 145.7 mph. By 1925 the Americans had earned a second consecutive win (the 1924 contest being declared void) due largely to the flying skill of Lieutenant Jimmy Doolittle, who went on to earn lasting fame during World War II with his audacious Tokyo raid. This second American win led to strenuous efforts on the part of the Italians and the British to deny them a third, and in 1926 the Italians duly took the Trophy with a Macchi 39. It was then won three times in succession by a series of Reginald Mitchell-designed Supermarine aircraft. The S5 won in 1927 at an average speed of 281.6 mph in

Venice. The race then became a biennial event and in 1929 the S6 won at 328.6 mph. However, as the time for the next race approached it became clear that not only had the British Government discontinued its support, the aviation industry seemed similarly disinterested. Fortunately Lady Lucy Houston came to the rescue. Variously described as an extreme patriot and an eccentric millionairess, she donated £100,000 to finance a new entry. Thus it was a spirit of enterprise that contributed directly to Britain's third consecutive win in September of 1931. Flight Lieutenant J N Boothman, flying an S6B — a modified version of Mitchell's previous winning design produced in barely 6 months — brought home the trophy permanently at an average speed of 340.1 mph. By way of a postscript, later that same month an S6B flown by Flight Lieutenant George Stainforth set an absolute speed record of 407.5 mph.

The significance of the Schneider Trophy competition is that it compressed 20 years of aircraft research into a mere six. It also led Mitchell to spend his final years (he died of cancer in 1937 at the age of only 42) pressing the British Government to use what was learned in these races to develop his design into one of the most important fighter aircraft of World War II: the Spitfire. This reinforces the thesis that progress in aviation has stemmed *inter alia* from a combination of pilot skill and engineering inspiration — underwritten invariably by bravery and an entrepreneurial spirit.

'Mutt' Summers took off from Southampton in the prototype Spitfire on 5 March 1936, paving the way for the first production aircraft which followed rapidly in June 1938. When Britain went to war on 3 September 1939 more than 2,000 Spitfires were already on order. The marriage of Mitchell's beautiful design with the formidable Rolls-Royce Merlin engine produced a world beating and, in every sense of the words, a battle-winning aircraft. More than 20,000 Spitfires in over 40 different variants were built. Although the last aircraft rolled off the production line in 1947, a number are

The marriage of Mitchell's beautiful design with the formidable Rolls-Royce Merlin engine produced a world beating — and in every sense of the words — a battle-winning aircraft

Mitchell's most successful design, the Spitfire

AHB (RAF)

AHB (RAF)

The first flight of a jet aircraft, the Heinkel He 178, took place at Marienehe on 27 August 1939

still lovingly maintained and flown by the RAF's Battle of Britain Memorial Flight.

The success enjoyed by the outnumbered RAF in the Battle of Britain owed as much to the daring of Spitfire and Hurricane pilots as it did to the quality of their aircraft. But in terms of courage — and here it is important to distinguish between spontaneous acts of bravery and courage of a sustained nature - there is little to compare with that exhibited by the crews of the RAF's Bomber Command. Their teamwork would represent a fascinating case study for human psychologists. Within Bomber Command itself no one exemplified courage more than Wing Commander Guy Gibson VC. His name will forever be linked with that of Barnes Wallis through their combined efforts to destroy three important German dams in the spring of 1943. Ordinary bombs could not damage these dams in the industrial Ruhr valley. However, Barnes Wallis came up with a unique solution. He designed an immense bomb, weighing nearly 9,500 lb, which rotated backwards at 500 rpm on release. This allowed it to sink down the face of the dam before a hydrostatic fuse triggered its detonation at a depth of 40 ft. The bomb's destructive power would then be magnified by the hammer effect of shock waves moving through an incompressible fluid. But to function correctly the bomb had to be delivered with extreme accuracy at 220 mph from a height of only 60 ft some distance from the dam; it would then skip across the water's surface, evading torpedo nets. The Lancaster crews used an ingenious system of converging light beams to achieve the correct release height. In a daring night raid Gibson and his handpicked crews destroyed the Möhne and the Eder dams and damaged the Sorpe. But of the 19 crews from 617 Squadron who took off on the 'Dambusters' raid, three failed to reach the target and eight were lost; 53 of 133 aircrew perished. While it did not produce the hoped for material effect, it did a great deal for a beleaguered nation's morale. Moreover the story of this raid reinforces the point that progress in aviation owes much to individual ingenuity, inventiveness and courage.

The next milestone in this journey through the past 100 years also occurred during World War II; however, its origins were much earlier. They go back to Trenchard's Royal Air Force College. Cranwell produced one of the true pioneers of British aviation — a man who can genuinely claim to be a world figure: Frank Whittle.

Britain did develop the first jet-powered passenger aircraft, the DH 106 Comet. When this airliner entered commercial service it created an immediate sensation — and considerable alarm on the other side of the Atlantic

It was Whittle who in 1928 spelt out in detail the technical requirements for the jet engine. He patented his design 2 years later but no one showed any interest, probably because the metals required had yet to be developed. In 1935 the patent lapsed, although Whittle later renewed it. It was not until 1936, when he obtained private backing, that he began to turn his designs into reality. Meanwhile, through the work of Hans von Ohain the Germans stole a march on Whittle and the first flight of a jet aircraft, the Heinkel He178, took place at Marienehe on 27 August 1939. Whittle's engine did not fly until nearly 2 years later, on 15 May 1941, in the experimental Gloster E28/39. However, thanks to his ingenuity, Whittle can justifiably claim to share with von Ohain the title of inventor of the jet engine.

Towards the end of World War II, in 1944, the Martin-Baker Company began their pioneering work in the field of aircrew ejection. The need for such a system was accentuated by the death of a pilot who used the standard over-the-side technique baling out when an emergency occurred while he was testing an early version of the Gloster Meteor. He lost consciousness and did not even attempt to open his parachute.

Martin-Baker is now the world leader in terms of ejection seats and escape mechanisms, having saved more than 7,000 aircrew lives, nearly half of them American. But if Martin-Baker is a household name, Bernard Lynch certainly is not. Yet 'Benny' (as he was better known) Lynch deserves the military aviation industry's admiration and gratitude. On 24 January 1945 he subjected himself to the first static live ejection test, up a ramp in controlled conditions. Eighteen months later to the day, on 24 July 1946, he completed the first live ejection test from a modified Meteor aircraft, flying at 320 mph and 8,000 ft. He went on to carry out more than 30 live ejections — every one of them quite literally a leap into the unknown. In the context of this treatise it is Benny Lynch who stands for all the unsung heroes — men and women of tenacity and grit — who have helped advance the cause of aviation in Britain.

Probably the most controversial airliner of modern times, Concorde, until the moment it retired from service, more than 34 years after its first flight on 2 March 1969, remained an elegant and distinctive sight — a masterpiece of innovative design

The next landmark in our journey occurred in June 1948. This was when the Soviet Union closed all road and rail communications with West Berlin, denying access to the British, American and French sectors. Fortunately both the RAF and the USAF were ready to mount an airlift to keep their garrisons supplied. But the respective governments decided to go a step further and supply the needs of the entire civilian population of West Berlin (over two million people). In an operation of unprecedented scale, the two Air Forces aided by British civilian charter airlines, ferried between 4,000 and 5,000 short tons of supplies into Berlin every day. The success of Operations PLAINFARE and VITTLES finally led the Russians to lift their blockade on 12 May 1949 after it had been running for over 10 months. This Operation demonstrated to the world the use of air power as a force for good in the humanitarian sense. It therefore represents an important milestone in the history of aviation.

Like the Schneider Trophy competition before it, the Second World War also telescoped decades of development in aviation into five or six years. But in the post-War world of commercial aviation to which we now turn Britain and the US adopted contrasting approaches. At the time it was said that the Americans listened to what the market was saying while the British kept building aircraft no one wanted. The US produced three sizeable propeller driven aircraft that met the newly created demand for long distance air travel: the DC3, the DC4 and the C12, better known as the Constellation. As a result, and in marked contrast with their British counterparts, American airliners were full. But in opting to take a different route Britain did develop the first jet-powered passenger aircraft, the DH 106 Comet. When this airliner entered commercial service it created an immediate sensation - and considerable alarm on the other side of the Atlantic. It was simply years ahead of its time. Unfortunately a poor accident record marred the aircraft's introduction. There were two early take-off accidents. No one was injured in the first, at Rome in October 1952. It was put down to pilot error and, as a result, higher air speeds were prescribed for take-off. The second accident resulted in the loss of all 11 people on board. It took place on a delivery flight from Karachi in March 1953 and was similarly attributed to an error of judgement on the part of the pilot. The solution this time was to modify the wing leading edge to increase lift at low speed and avoid the possibility of stalling on take-off. Then a third tragedy occurred, in January 1954, when the aircraft entered a violent thunderstorm just after take-off from Calcutta. It simply disintegrated in mid-air. At the time it was regarded as no more than a freak accident, on the grounds that turbulence within a severe thunderstorm could literally tear an aircraft apart. The Comet was nevertheless grounded for nearly two months while 50 modifications were carried out — despite the fact that the precise cause of this terrible accident remained unknown. It was not until a fourth accident, in

April 1954, when an aircraft departing from Rome again broke up in mid-air, resulting in the loss of all 43 people on board, that long, detailed and methodical investigations into the precise circumstances began.

This sad story is worth recounting in order to highlight the persistence, the skill and the ingenuity of those in the aviation industry who finally isolated the cause, which turned out to be metal fatigue. The inquiry itself involved the Royal Aeronautical Establishment at Farnborough and was chaired by its Director, Sir Arnold Hall. The sort of men and women who meticulously researched this accident — and hundreds of others like it over the years — have done much to advance the cause of flight safety in both civil and military flying.

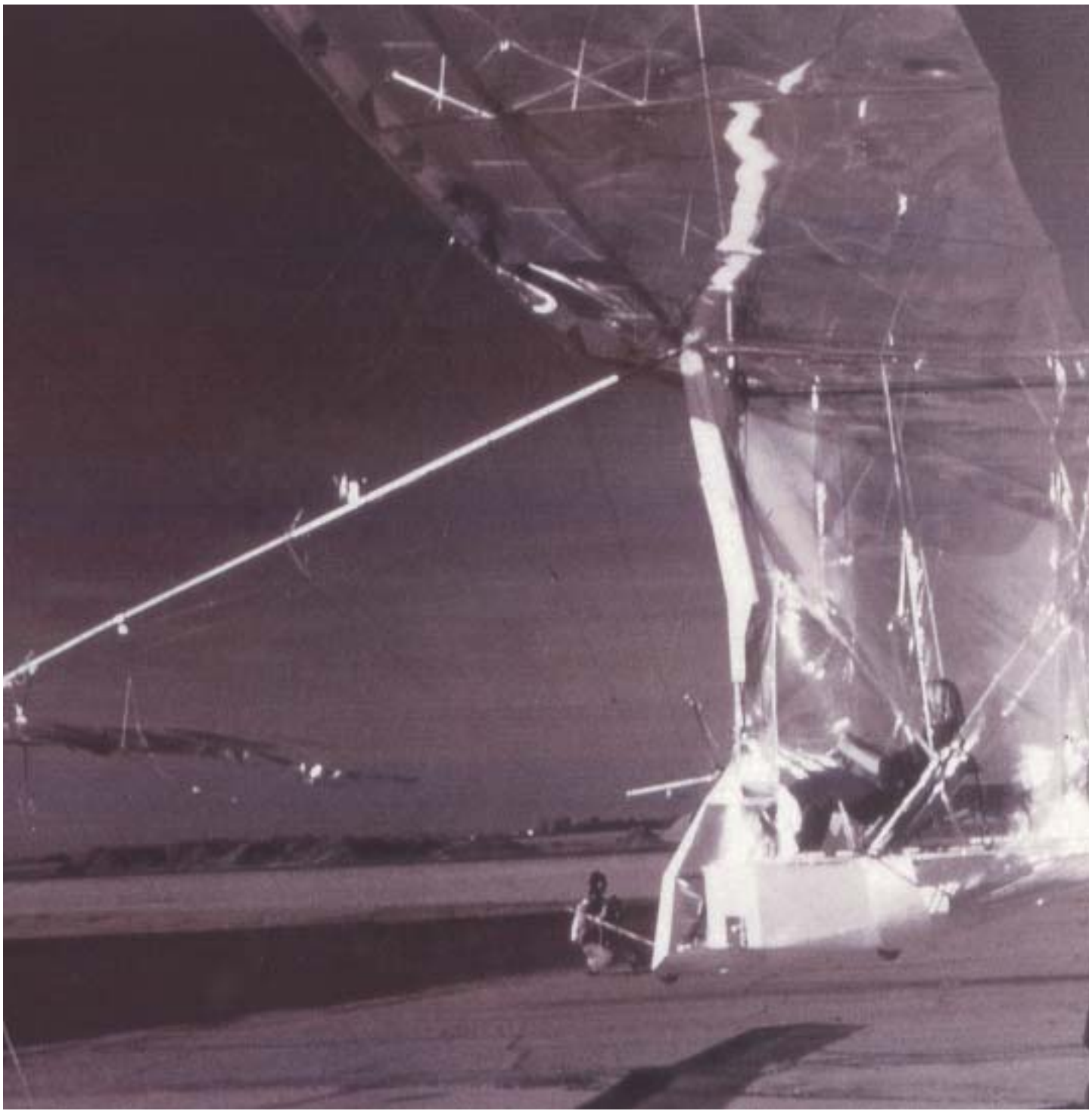
It is perhaps ironic, given earlier references to Anglo-French rivalry, that one of the finest technological achievements in airliner history, and probably the most controversial airliner of modern times, Concorde, should have resulted from co-operation between Britain and France. Until the moment it was retired from service, more than 34 years after its first flight on 2 March 1969, it remained an elegant and distinctive sight — a masterpiece of innovative design. Concorde's future though was always beset by doubts. The reasons for this included high operating costs, what were considered to be high noise and smoke emissions and, most recently, safety concerns that emerged after the Paris crash of July 2000 in which 113 people died. The temporary grounding that resulted was effectively compounded by the longer-term impact on premium air travel of the New York terrorist attacks on 11 September 2001, and undoubtedly contributed to the aircraft's ultimate demise.

Concorde effectively spanned the latter half of the century of aviation. Developed in the 1950s, it was not until 26 January 1976, 14 years after Britain and France finally agreed to build the aircraft, that Concorde entered commercial service. Unfortunately it failed to sell and routes soon had to be consolidated. Then, in September 1979, the British and French Governments halted production after building only 16 aircraft. The total cost of the programme has been put at £3 billion. It was the most expensive and in some ways the most disappointing airliner the world has seen. Until its final withdrawal from service with British Airways in October 2003 (Air France grounded their aircraft 5 months earlier) it remained a shining example of the aviation industry's technical capabilities. Moreover, in bringing together key elements of the European aerospace industry in a hitherto unprecedented manner the project effectively presaged the commercial success subsequently enjoyed by Airbus.

Returning to the military field, no discussion of British aviation would be complete without mention of the Harrier. The origins of this novel aircraft lie in the mid-1950s. The British Government's first venture into the vertical/short take-off and landing (V/STOL) arena was Shorts' delta wing, fixed undercarriage SC1. It required four RB108 lift engines for vertical flight, together with a single RB108 for conventional, wingborne flight. However, practical application of this concept proved difficult. The second prototype SC1 crashed in 1963, killing the pilot. While all this was going on Hawkers were pursuing their own ideas in the V/STOL field — ideas that led eventually to the Harrier, via the Rolls-Royce 'flying bedstead' and the P1127 prototype.

The P1127 first flew in October 1960 and employed a different approach - vectored thrust and a jet reaction control system. But it should be acknowledged that it was a French engineer, Michel Wibault, who first proposed the concept of directing, or vectoring, the thrust of a jet engine. As a further aside, it is interesting to note that a similar design battle between the lift engine concept and vectored thrust was played out in the competition between Boeing and Lockheed Martin for the lucrative Joint Strike Fighter contract, won by the latter company in 2001. Back in the 1960s several countries were drafting requirements for V/STOL combat aircraft. This led to an agreement early in 1963 between Britain, the Federal German Republic and the USA to purchase nine developed P1127's. These aircraft were to be used in a tripartite evaluation programme with the objective

Dr Paul McReady, claimed the second Kremer prize of $100,000 for the first man-powered flight across the English Channel, this time with his Gossamer Albatross



Eurofighter Typhoon

It will take the Royal Air Force, and the Air Forces of the European partner nations, into a new era in terms of performance and capability

of establishing the ground-rules for V/STOL fighter operations. The aircraft was designated the Kestrel in November 1964 and was seen initially as the precursor of the soon to be cancelled TSR2. It was only with the February 1965 cancellation as well of the P1154 (the supersonic V/STOL strike fighter the RAF adopted after loss of the TSR2) that the RAF took the Kestrel into front line service. The aircraft adopted the Harrier name selected for the ill-fated P1154 but was itself fortunate to escape cancellation by Dennis Healey in his 1966 Defence Review. The Cabinet at the time simply could not face another politically damaging cancellation. Though Healey stuck to his guns he faced opposition from the Ministry of Technology and rising costs elsewhere (in particular the RAF Phantom programme). The result was that by December 1966 the way was clear for negotiations on an initial production order of 60 aircraft. The rest, as they say, is history.

By way of a postscript on this remarkable aircraft, in May 1969, 50 years almost to the day after Alcock and Brown conquered the Atlantic, the Daily Mail sponsored a repeat race, this time between London and New York. As before the rules were complex, involving fixed start and finish points in the heart of each city. The east-west leg was won by an RAF pilot, thanks to the versatility of the Harrier. Squadron Leader Tom Lecky-Thompson completed the journey in six hours 11 minutes and 57 seconds, using a rail yard for take-off and a motorbike as transport through town — yet another example of both human and engineering ingenuity.

At this stage it is important to emphasise that the spirit of enterprise and competition, so evident in the past, is still with us. In 1959 a British industrialist, the late Henry Kremer, offered a cash prize of £5,000 for the first human-powered aircraft that could fly a figure of eight around two markers 800 meters apart — the same performance level as the early Wright Flyers. However, it was some 20 years before this prize was finally claimed, by which time it had grown to £50,000. On 23 August 1977 it went to an American, Dr Paul McReady, with his Gossamer Condor design. Two years later he claimed the second Kremer prize of £100,000 for the first man-powered flight across the English Channel, this time with his Gossamer Albatross. While there may not be a commercial future in this field, it is worth recording that, by courtesy of Kremer's generosity, the Royal Aeronautical Society currently has on offer over £100,000 in prizes for three new sporting competitions, all designed to further the cause of human-powered flight.

A treatise such as this would be incomplete without mention of Eurofighter Typhoon. It will take the Royal Air Force, and the Air Forces of the European partner nations, into a new era in terms of performance and capability. The aircraft is a product of collaboration between Germany, Italy, Spain and the UK — collaboration at Government, industry and Air Force levels. In the eyes of independent experts, its cockpit - designed by pilots for pilots — is the best in the world, thanks not least to the use of DVI (direct voice input). The aircraft structure itself utilises carbon fibre composites, lightweight alloys, titanium and glass reinforced plastics. Unstable by design, it relies on a computerised control system that provides outstanding manoeuvrability, particularly at supersonic speeds. With a Mach 2 and +9/-3G capability, and an outstanding weapons system based *inter alia* on the ASRAAM and Meteor missiles, it is quite simply a world-beating swing-role aircraft. Sadly, it is likely to be the last fighter aircraft designed and produced in the UK. But those disturbed by this prospect can take at least a crumb of comfort from the fact that the same was said in 1957 of the TRS2 — and by the Deputy Chief of Air Staff at that.

But where is the human link here? It lies in the vision and persistence of those within British industry involved with Typhoon's precursor. Decades ago, after withdrawal of the Germans and Italians, these individuals worked diligently to turn their aspirations first into the Experimental Aircraft Programme (EAP) and ultimately into the reality of Typhoon. There can be little doubt that by keeping the EAP alive British Aerospace (*sic*) ensured that the Ministry of Defence specification for an agile fighter was eventually resurrected. In this context we must acknowledge too the skill of the designers and engineers who helped create this remarkable aircraft.

So what of the future? In aircraft terms, and largely because of costs, the UK's aviation future is likely to be a collaborative one: with the US and others on the Joint Strike Fighter/Future Joint Combat Aircraft project and with Europe in the Airbus consortium. The years ahead are also likely to see greater concentration on unmanned vehicles, systems development and systems integration – all in concert with increased emphasis on network enabled capability.

Aviation has come a long way since 17 December 1903. We have inherited a legacy of enterprise, innovation, ingenuity, tenacity and courage. There can be little doubt that these very same qualities — human qualities — will be needed in the next 100 years, no matter where future of aviation may lead.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301

UK Long Range Offensive Air Power for 2020 and Beyond

By Air Commodore Tim Anderson

The Future Offensive Air System (FOAS) programme is a discrete acquisition programme intended to fulfil the UK's future long range strike capability requirements from the end of the next decade out to 2050, and quite possibly beyond. The programme has continued to evolve throughout the last four years of its Concept Phase as the context and nature of the operational requirement have become more clearly defined. At this stage in its genesis, FOAS is envisaged as providing a suite of capabilities that will complement and reinforce those which will be provided within the nearer term by the UK's aircraft carrier-capable Joint Combat Aircraft (JCA) Force comprising the Short Take-off and Vertical Landing Joint Strike Fighter and Typhoon.

The FOAS programme's Initial Gate is approaching and it is anticipated that it will be followed by an Assessment Phase designed to offer a detailed analysis of the broad range of candidate systems identified during the programme's Concept Phase

The most promising candidate systems include a mix of long-range stealthy manned aircraft, UCAVs, and highly developed cruise missiles launched from a variety of platforms

and their inter-relationships, culminating in a nominal production Main Gate in 2009 and system In Service Date of 2017. While the UK MoD has identified these timescales for planning, it recognises that the both the nature of the requirement and the spread of possible contributors to fulfiling it are likely to manifest themselves in an incremental approach to acquiring the overall capability, with the obvious implications for a unitary Main Gate or ISD.

Meeting all the implicit core system requirements of *responsiveness*, *reach*, *sustainable weight of effort*, *ubiquity* and versatility simultaneously is only likely to be affordable through air and air vehicles. Without 'solutioneering' the requirement, the most promising candidate systems identified during the Concept Phase thus far include a mix of long-range stealthy manned aircraft, UCAVs, and highly developed cruise missiles launched from a variety of platforms. Nevertheless, the extent to which any or all of these candidates ultimately contribute to satisfying the core requirement will be determined during the Assessment Phase with the aim of having a reasonably well defined idea of the optimum system force mix by 2008. It is assumed that the capability of the overall system will be enabled and enhanced by an integral, but fully interoperable, C4ISR network that will form a key element of the UK's future Network Enabled Capability.

Aim

The aim of this essay is to explore developing thoughts on what the future might require of the UK's long range offensive air power capability and, in particular, to set the FOAS capability requirement in the overall context of the UK's evolving defence needs. I must stress, however, that I will be describing emerging themes, occasionally from a personal perspective, and not all of my comments should therefore be regarded as authoritative statements of endorsed UK defence policy. Nevertheless, in doing so, I will attempt to encapsulate the UK doctrinal context and policy drivers — to elaborate a little on the 'Why' of the FOAS requirement. A brief assessment of the global geo-political scene will hopefully point to the 'Where' and the 'Who', before I attempt to show how the evolving FOAS requirement has also been shaped, to a greater or lesser degree, by developments in warfighting and lessons identified from contemporary campaigns over the last decade or so.

Other forums and authors have provided their own insights into the nature and utility of offensive air power in the round and its relationship with Effects Based Operations (EBO). In the space available I will therefore touch only briefly on this area. However, this and what is already in the public domain with regard to our developing EB doctrine will, I hope, serve to underpin the rationale regarding some of the Key System Attributes I believe FOAS must possess if it is to help address both current and future UK capability gaps for long range precision strike. Finally, I will outline where I see the key challenges facing the FOAS programme — challenges that in many cases, of course, are not exclusive to the UK.

Timing and planning

As a prelude, it is perhaps worth pausing for a moment to consider the FOAS timeframe in a little

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more detail. The changed environments in which the system will be required to operate within the third decade of this century and beyond, and the threats it will have to contend with, are likely to be as polarised from now as those of the early 1960s. Then, surface-to-air and air-to-air missiles were in their infancy, surveillance and target acquisition sensors were relatively crude and 'stealth' was an arcane art confined to the annals of research. Contrast that with the US Patriot and Russian S-400 families of SAM systems; high-speed and super agile air-to-air missiles equipped with multi-spectral sensors that are effective over very long ranges; stealthy bomber and super-cruising fighter aircraft; and the advent of directed energy weapons operating at the speed of light, all of which offer demonstrated capabilities *today*.

Moreover, since the advent of the industrial age, technological advance has only ever accelerated. Clearly, therefore, looking ahead to the FOAS timeframe, FOAS will be required to deliver a quantum leap in capability if it is to provide a meaningful contribution to our overall offensive air capability throughout its service life, and not just at its beginning.

An inherent strength of the UK's planned iterative approach to sustaining our offensive air power capability through acquisition of Typhoon, JCA and FOAS is that it minimises the risk of a cliff edge end to this pivotal capability as one system's effectiveness inevitably declines. Instead, it generates an enduring squad consisting of 'workhorses' capable of dealing with the more utilitarian end of the requirement spectrum, operating alongside 'thoroughbreds' that retain a qualitative edge over potential and real opponents.

Thus, in the nearer term, Typhoon will complement Tornado GR4 and will offer real capability operating in, and conditioning, hostile air environments populated by advanced combat aircraft systems; similarly, JCA's arrival at the end of this decade will complement Typhoon and will offer a distinct improvement in survivability in dense, high-threat IADS environments as they proliferate in the medium term; and further ahead, FOAS is our prudent investment in the future that will continue to ensure a sharp tip to the spear as JCA reaches middle age and beyond.

An unpalatable alternative to this overall approach would be to over-invest in today's leading-edge technology, only to risk finding that a decade or so later even significant upgrading of the extant fleet could offer nothing better than a stopgap capability in the second half of its useful life. In parallel, the essential groundwork that must underpin maintaining a sustained level of offensive air capability commensurate with UK defence and foreign policy, such as planning far enough ahead to take advantage of new technologies, react to emerging threats and allow for the timescales of subsequent system development and production, would be likely to atrophy.

Conceptual and doctrinal framework

Within the MoD's Equipment Capability Customer (ECC) area our work benefits from a considerable amount of informed strategic guidance and policy direction. Some of this resides in the public domain such as the Strategic Defence Review and SDR New Chapter, and some, for obvious reasons, remains on a more restricted circulation. However, the coherence throughout is striking. This strategic guidance, and supporting High Level Operational Analysis between them identify both enduring and emerging themes that underpin and inform British defence policy and thinking, and will undoubtedly continue to do so. At the heart of this thinking rests our philosophy of a 'Manoeuvrist' approach to operations. In itself, this is underpinned by a developing EB doctrine that appears set to place a significant emphasis on Deep Operations enabled by Knowledge Superiority and Information Operations.

Both the philosophy and the developing doctrine will of course have profound implications for force development in general, and offensive air power in particular, since it is this capability that lies at the heart of being able to reach out and influence an opponent quickly and in a manner that, when necessary, is capable of evoking acute Strategic Effect. Moreover, notwithstanding the developing tenets of EB doctrine, the core roles of offensive air power, such as Air Reconnaissance/Surveillance,

The ability to act quickly and effectively in response to developing situations, possibly at considerable distance from friendly territory, will be paramount

Offensive Counter-Air Operations and Anti-Surface Force Air Operations are unlikely to diminish, particularly when focused against an opponent's fielded combat and fighting power. As such, it is likely to remain a premium value capability and one that we can assume with strong confidence will continue to feature highly on both our own list of essential capability requirements and those of our allies.

In considering our future capabilities today in the round, Swift Strategic Deployability, an EB Approach to operations, effective Information Operations and a greater emphasis on Deep Operations have already been identified as key criteria against which all new capabilities should be judged. Clearly, it is vital that FOAS is fully aligned to, and coherent with, such guidance as inevitably FOAS will have an important, and probably central, role to play in translating our doctrinal approach into future campaign success. It should come as no surprise, therefore, that FOAS' conceptual basis is coherent with the UK Joint Doctrine and Concepts Centre's emerging High Level Operational Concept (HLOC), which reiterates that reach and flexibility are essential to future capabilities.

The geo-political scene

If strategic guidance, policy direction and developed doctrine provide us with the 'Why' for effective future offensive air power, assessment of the global geo-political environment gives insight into 'Where' we might need to deploy and employ military capability, and 'Who' we could find ourselves operating alongside, and against. The geographical breadth of the UK's responsibilities is unlikely to diminish in the foreseeable future. Our historical ties, partnerships and associated influence across the globe, economic status, intimacy with a burgeoning Europe and transatlantic relationship will all continue to serve to generate dynamic obligations for the UK on a near-global canvas.

British military involvement over the last 13 years in the Gulf Region, the Balkans, Africa, Afghanistan and even as far afield as South East Asia is testament to this. However, our capacity to act over a large part of the globe is unlikely to be able to rely on sustained forward presence, such as that seen in Europe in the Cold War, or even today with US forces on the Korean peninsula, as it is likely to be neither desirable politically, nor affordable. The availability of access, basing and over-flight rights in support of any surface force required to deploy into a theatre, not forgetting its enabling capabilities, will also be highly situation dependent.

Moreover, the nature of the threat to UK interests abroad and at home has changed and will undoubtedly continue to do so. Although the incidence of conflict will remain certain, the causes, timing, location and nature of that conflict will remain as uncertain. Failing and rogue states are likely to affect regional stability. State support for terrorist organisations — be that overt or covert – will continue to fuel terrorist activity and attacks across the globe. The non-linear threat posed by non-state actors, especially those in the future with access to weapons of mass effect, will call for novel, probably time sensitive, and certainly decisive, countermeasures.

Therefore, the ability to act quickly and effectively in response to developing situations, possibly at considerable distance from friendly territory, will be paramount. A capability to create early and decisive effects, where and when we need to, whether opposed or not, and not just when we are afforded the time to build up to an event, will be an increasingly critical element of our ability to face down, and ultimately remove, acute threats to

One's passport was dusted off for a major US exercise, and perhaps a NATO Squadron Exchange every year. Twelve years later, our squadrons can expect to spend up to five months a year away on operational duties

our security, and that of our allies. We should not forget too that, throughout, the requirement to retain public support and obey international law will ensure that we shall wish and need to maintain the moral high ground, even against enemies who have little or no interest in its occupation.

Developments in warfighting

We in the ECC area are always mindful of the dangers of planning to fight the last war when seeking to identify lessons from recent operations that might guide our definition of future capability requirements. However, there are some clearly identifiable themes shaping the continuing development of offensive air power that FOAS will wish to reflect. Firstly, the ever-increasing need for precision, both in munitions themselves and in the targeting process. In the 1991 Gulf War, the RAF's ratio of precision-guided munitions to 'dumb' weapons was 1:9.

During recent operations in Iraq, that ratio was reversed. The MoD's Strike Capability Manager's weapons strategy to 2020 is predicted on an inventory of almost entirely precision guided and precise munitions that will offer a range of effects against fixed, movable and moving targets be they soft or hardened, and unconstrained by light levels or weather. Fuelling this drive towards precision is more efficient use of resources, allied to the accelerating demand for ever lower levels of collateral damage, and interestingly, an ability to reduce the attrition caused to our enemies' fielded forces, where that is deemed desirable. In conflicts where the regime/leadership is identified as the focus of our military operations, public opinion at home and, crucially for post-conflict settlement within the regimes homeland, may be best influenced by just such a precisely orchestrated effects-based campaign.

Secondly, our forces will need to be configured for expeditionary operations. In Anthony Cordesman's initial assessment of the lessons to be learned from Operation IRAQI FREEDOM , it is gratifying to note his acknowledgement of the positive changes in RAF operating posture between 1991 and 2003 and the Service's ability to rapidly relocate its air power platforms in the light of a rapidly, and unexpectedly, changing political situation. In 1991, with some notable exceptions, the RAF fast jet fleets were tied to Main Operating Bases with a well-founded, but similarly well-rooted and inflexible, support infrastructure.

One's passport was dusted off for a major US exercise, and perhaps a NATO Squadron Exchange every year. Twelve years later, our squadrons can expect to spend up to five months a year away on operational duties or other detachments, with the capability to deploy measured in hours not weeks. This systemic expeditionary capability serves to underline offensive airpower's unparalleled responsiveness and reach, and its utility across the widest range of military tasks, but we must become even more agile. If we are to divest ourselves fully of monolithic force structures, rooted face-to-face with the threat of the day, we must be certain that thereafter we can get combat power to where we need it whenever it is required and for however long it is required, and that it is capable of creating the desired effects irrespective of the benignity or otherwise of the environment. In future, the ability to deploy quickly to, operate within, and to condition for follow-on forces what our US colleagues term 'anti-access' environments is likely to be key.

Together, this emphasis on precision effect delivered by forces organised and equipped for

Boeing's UCAR concept UAV

UCAVs and UAVs will before long have to demonstrate clear operational and cost advantages across a variety of roles if they are to secure places for themselves in the earlier iterations of the FOAS Force Mix

expeditionary warfare underpins the third clear theme — the move towards smaller, lighter forces able to employ decisive combat power when required. The MoD Deep Target Attack Equipment Capability Directorates vision is, by 2020, to field 10 times the effect of long range strike weapons systems, with one-tenth the deployed logistical tail, 50% of the manpower and at half the cost of ownership compared to 2002. Advances in technology, structures and affordability will see offensive air power in the vanguard of realising this challenging vision.

Enabling technologies

New technologies will offer the UK the potential to achieve its politico-military objectives in different ways and may indeed provide the means to conduct traditional military tasks and roles in previously unimagined ways. Most obviously, UCAVs and UAVs offer the potential for transformational change in the way that offensive air power is organised, sustained and delivered; it will come as no surprise, therefore, that the UK continues to be actively engaged in research and analysis in this nascent area. Given the ever-present pressures on defence expenditure, UCAVs and UAVs will before long have to demonstrate clear operational and cost advantages across a variety of roles if they are to secure places for themselves in the earlier iterations of the FOAS Force Mix.

Advances in enabling capabilities such as C4ISR and the supporting sensors and data networks, particularly in the deep battlespace where third party ISR information may be limited at best, will also be critical. However, to what extent these overarching capabilities enable, or are enabled by, potentially complex component systems such as FOAS is a balance we have yet to define fully: in all probability they will prove to be dynamic. We may also find ourselves undertaking military action in the future against adversaries who have not been rigorously analysed and modelled during the decade preceding conflict. We will therefore need the capability to model or predict the battlespace prior to our attempts to shape it — knowledge superiority is after all a *sine qua non* for unleashing the potential of EBO. It is axiomatic that without it, our warfighting will in all probability be incoherent and certainly reduced in effectiveness.

Advances in computing power and in propulsion, fuels, materials and aerodynamics will all contribute to our ability to extend air power's reach and increase its speed of response even further. Evolution of passive stealth techniques and the fielding of active techniques will underpin acceptable levels of survivability, whilst facilitating access to an opponent's most closely guarded vulnerabilities, or his systems that pose us the highest threat. FOAS will call upon all of these advances and, moreover, technological advances in design and manufacturing will have a part to play too if our aspirations are to be converted into affordable capability. Percolating through all of this adaptable, advanced synthetic environments and the fidelity of training and mission rehearsal they will enable, will serve to maximise the effectiveness of the physical and moral components of our offensive air power capability and are likely to be key capability enablers in the FOAS timeframe.

FOAS key system attributes

So how then might the doctrinal context, emerging and enduring trends in warfighting, and advances in technology shape our view of offensive air power's future utility and nature, and in turn help us to define the capabilities the UK might require of FOAS? I would like to answer this by outlining the key system attributes (KSAs) that I currently believe FOAS must possess as a system in order to offer us the insurance of a qualitative edge over potential adversaries through the medium of long-range offensive air power. Clearly, defining these KSAs as attributes that the overall system should possess is not to say that a sub-system possessing some of them is necessarily a suitable candidate component. Moreover, whilst I will discuss each attribute in turn, in reality they will be closely inter-linked and inter-dependent as befits a system of systems. Nevertheless, if nothing else, I hope identifying them in this manner will help illuminate the envelope of the required FOAS capability and perhaps stimulate thought and debate.

Reach

As I intimated above, analysis of the geo-political landscape provides us with pointers as to where FOAS may be required to operate and underpins the attribute of '*reach*'. Not that the requirement for air power reach is some new invention, as evidenced by strategic operations in both World Wars through to, more recently, the 3,500 nm round-trip missions conducted by RAF Tornados operating from Germany during Operation ALLIED FORCE in the Balkans. To help safeguard the UK's vital interests, FOAS will require the capability to hold at risk targets wherever they may reside within the UK's area of strategic regard. This FOAS attribute will give the UK the ability to engage adversaries on their own doorsteps and — coupled with *responsiveness* — at a time of our choosing.

FOAS will give the UK the ability to engage adversaries on their own doorsteps and — coupled with responsiveness — at a time of our choosing

Nor will this ability be limited to the prosecution of 'terrorist' targets. Long-range offensive air power will be an essential element of any integrated campaign in anti-access environments. It must be assumed that our future opponents will also have learnt lessons from recent conflicts and, therefore, enhancements can be expected in their surveillance capabilities (including space-based), air and maritime defences and accurate long range strike capabilities. Intuitively, this in turn will generate a requirement to shape and condition the battlespace whilst standing off by significant distance; to be able to provide a counter-force suppression and/or disruption capability that will permit the subsequent deployment and employment of friendly surface forces adjacent to and within the theatre of operations, and to be capable of achieving this from a posture that is beyond the initial area of vulnerability.

A B1-B delivers its weapon

We are now coming to expect one platform to be able to create multiple effects against a range of targets in one mission iteration, shown most graphically in Iraq recently with the use of multiple JDAMs from USAF B-52 and B-1 bombers

This important element of what can be described as a 'Day One' capability must address the application of effect against the most demanding of targets, probably at extended range from the UK, Sovereign or allies' territories, and in the highest of threat environments. In doing so, we will clearly wish to watch closely evolving US concepts for timely effect at range to enable, where possible, the UK to meet its desired level and extent of commitment to coalition operations. It would also seem sensible to assume that, in order to turn aspiration into reality, some level of organic ISR capability will be required within elements of the FOAS force mix; some of the targets we may be required to prosecute could quite possibly be beyond the range of detailed third party-supplied battlespace information.

Effect

Traditionally, offensive air power has visited lethal kinetic weapon effects on an adversary and, even in the EBO era, this is likely to remain its *raison d'êtr*e for the foreseeable future. Whether employed in direct military action for strategic effect, focused on an opponent's strategic centre of gravity, in support of the other instruments of power marshalled in pursuit of an indirect effect, or when applied in support of friendly forces directly against an enemy's combat power, the requirement to harass, disrupt and destroy by application of '*precise kinetic effect*' is likely to endure.

Historically, imprecise munitions and delivery techniques generated an often substantial *over target* requirement in terms of aircraft needed to ensure target destruction. Recent advances in weapons and their targeting have reversed this paradigm — we are now coming to expect one platform to be able to create multiple effects against a range of targets in one mission iteration, shown most graphically in Iraq recently with the use of multiple JDAMs from USAF B-52 and B-1 bombers. In the future, weapons such as the Small Diameter Bomb will extend an element of this capability to smaller platforms such as JSF. FOAS will wish to continue and exploit this trend.

However, we should be wary of assuming that this shift will be matched by a directly proportional reduction in the overall *number of sorties*, and therefore platforms, required to prosecute an air campaign, even with the increased serviceability offered by modern systems. Our growing ability to

find and strike precisely targets of increasing granularity, whilst minimising collateral damage in the target's environs will make possible and increasingly desirable the capability to write down an opponent's fielded forces to an extent not achievable before.

Notwithstanding EBO, we must assume that the future will still feature adversaries equipped with large standing forces matched with a willingness to commit them to initiating, or sustaining, their aggression. Leading on from today's casualty-averse political environment, our willingness to commit sizeable formations of our own surface forces into discretionary engagements with a competent and stubborn opponent will inevitably be conditional upon prior battlespace preparation by long-range strike systems, and escort of friendly surface forces by air power through a coordinated air/land battle and joint manoeuvre.

However, the capacity to set the conditions for success and minimise friendly casualties comes at a price. Firstly, as ever, air superiority must be established (possibly from a standing start, as opposed to over a period of years as witnessed recently in Iraq) and maintained and, secondly, sufficient weapons (notwithstanding precision, in the order of many hundreds as a minimum, and much more probably thousands) must be brought to bear across the full breadth and depth of the battlespace. Add to this counter-force air operations and, even with the coming promise of a wholly multi-role FJ force and the contribution from long range surface systems, this is likely to translate into a potentially large overall sortie requirement.

Nevertheless, increasing precision will obviously be a facilitator of our ability to shape the battlespace surgically. It will permit reductions in warhead and weapon size — for the routine, we will be able to achieve the required effects with less. This will have significant additional macro benefits, both in enhancing our ability to fight efficiently from a logistical perspective, and from the point of view of minimising any parasitic drag on the tempo of other components of the operation as a result of diffuse destructive effects. We are also re-learning that conflicts with an end state of regime change are likely to carry a high additional tariff for post-conflict reconstruction, as we are witnessing in post-Saddam Iraq. Clearly, this would be eased and accelerated by limiting physical destruction to the minimum necessary.

Moreover, it may well be that the coming years see an increase in the use of non-lethal effects, using various novel warheads and damage mechanisms, especially when one factors in the asymmetric advantage this could provide. In the UK, we would obviously be interested in any developments in this area that would give clear warfighting benefits and, where and when available, would expect to field these capabilities as part of an integrated FOAS solution. Nevertheless, perhaps the existence of the USAF's Massive Ordnance Air Blast weapon suggests that the day of the 'big bang' is not completely over.

Responsiveness

However, being able to deliver a kinetic or non-lethal effect is irrelevant if we are unable to also create it at the desired time. For FOAS, this attribute is likely to encapsulate a number of complementary requirements. For example, SDR New Chapter specifically identified that '*New elements and capabilities are needed to seize what may be fleeting opportunities to engage terrorists (and) to deal with them in remote areas*'. FOAS' emphasis on '*speed of response*' embraces this notion but develops it further to include recognition of the different contexts we may be required to operate within. Thus, the ability to apply precise effect, constrained by the bounds of proportionality and legality, perhaps within *hours* of any non-prescient political decision to act, coupled with the more general ability to detect and attack the most stressing time sensitive targets located within a hostile environment, are key goals that will be pursued in attempting to deliver a suitably responsive long-range offensive air capability through FOAS.

Moreover, a highly important incidental benefit of speed of response is the inherent and unique ability to sustain weight of effort at considerable range that it conveys upon air systems, by virtue of their ability to support rapid task/replenishment cycles.

Tornado F3s patrolling the no-fly-zone over iraq

FOAS must therefore exercise 'presence' as well. Historically, 'presence' has not been regarded as one of air power's strengths

Overarching all of this, achieving the correct balance between 'hunter-killer' and cued operations, whether from manned aircraft, or even air-launched armed UAVs, will be critical to delivering a truly responsive capability in the FOAS timeframes. Within the MoD's Deep Target Attack Directorate, significant work is being done to identify a holistic way forward in this area – how we can minimise the 'sense – decide – effect' timeline — through our Kill Chain Development Initiative.

Presence

Ultimately, extended reach and speed of response will satisfy only part of the wider system requirement. The system must also be capable of enduring for prolonged periods, to hold the enemy's target set at risk, or provide the time to build an operating picture, identify significant events and react to them appropriately. FOAS must therefore exercise 'presence' as well. Historically, '*presence*' has not been regarded as one of air power's strengths.

Contemporary operations such as the policing of the Iraqi no-fly zones have energised the evolving concept of 'air presence'. Moreover, air-to-air refuelling and uninhabited air vehicles, coupled with recent advances in technology — from materials to power storage and propulsion — are already offering very significant advances in air platform persistence. FOAS must be able to attack targets around the clock without pause or interruption. This capability will allow us to exercise the spectrum of capability, from deterrence through to physical destruction if required, and must require the minimum possible logistic support. Accordingly, its systems will require significant operating periods without replenishment, servicing or support.

Robustness

'Presence' is insufficient in itself: it must be matched with '*robustness*'. We must assume that the threat environment within which FOAS Force Elements will be required to operate, extending out to 2050, will be multi-layered, highly complex and resilient. Whilst we have been fortunate in recent years not to have come face-to-face with them, advanced and highly capable air defence systems *already exist*, and are available to those with the desire and requisite means to acquire them. Moreover, their attractiveness can only increase in the light of recent operations. Proliferation of advanced SAM systems such as the S-300/400 family and their derivatives, advances in passive and active detection capabilities, and the air-to-air threat posed by fourth generation fighters armed with highly agile missiles will undoubtedly be the routes chosen by many potential adversaries over the coming decades in their attempts to blunt offensive air power's edge.

Developments in the field of Directed Energy Weapons and the potential threat they will pose to humans, sensors and other electronic systems, will provide a further complication. The continuing effectiveness of offensive air power will be reliant upon the development and adoption of survivable new systems, driven by technological advances and novel operating techniques. The introduction

of JCA in 2012 will provide the UK with its first Low Observable air platform, promising greatly enhanced survivability and mission effectiveness. Thereafter, as we project forward into the FOAS timescales, platform survivability across the FOAS candidate systems is likely to require an evolving combination of active and passive techniques, anchored around core characteristics such as Low Observability and speed.

Interoperability
Whilst the UK will wish to retain the capability to act autonomously at up to medium scale if our national interests are threatened, we are more likely to be called upon to operate within the framework of a coalition, be that with the US, other NATO nations, EU states or further afield.

'*Interoperability*' with our allies — and given their technological and military might, particularly the US – is a further key system attribute. The speed of response required may not allow for a staged build-up and we will need to be fully familiar with potential allies' modus operandi (and recognised as such) and capable of networking fully from the outset.

In broad terms, the ability of FOAS force elements to contribute to and receive the wider Joint Operating Picture, and to exchange sensor data with other FOAS and non-FOAS constituent systems, will be critically dependent on the realisation of the UK's Network Enabled Capability. But, within this, any organic FOAS C4ISR capability will also be a major component of the air element of NEC, and probably beyond. Moreover, we will wish to avoid building into the system more dependencies than are necessary if we are to retain free access to air power's inherent characteristics of flexibility, adaptability and ubiquity across the length and breadth of the battlespace.

Clearly, too, interoperability means more than just network-enabled. As I mentioned earlier with reference to the necessity of a 'Day One' capability, we will need to provide a credible and useful contribution to all stages and elements of a campaign, and resist the notion that someone else will look after the 'difficult stuff'. We will need FOAS to integrate seamlessly into Joint and Combined operations. Any shortfalls in the interoperability arena will almost certainly degrade overall system effectiveness and severely constrain the contribution FOAS will make to EBO.

Legality
Lastly, FOAS must operate at all times within the Rules of Engagement pertaining to a specific operational theatre and the overarching considerations and strictures of extant international law, including any future developments thereof. An integrated approach, extending from the development of multi-spectral and high fidelity sensors offering broad utility across the spectrum of battlespace terrain, through alignment with an effective C2 architecture, to ongoing legal review of the developing programme aims to ensure that FOAS will be compliant in this vital area.

Challenges
I offered to highlight briefly some of the challenges I foresee facing the future application of effective offensive air power and in particular the delivery of FOAS. Fundamentally, we will need to ensure that our C4ISR architecture is robust, has the potential to handle increasing data exchange demands and possesses both redundancy and graceful degradation to cater for the worst cases. It must also be capable of catering for increasingly complex, potentially non-linear, scenarios, including operations in urban terrain. Moreover, the amount of information available versus that required, or even useful, is likely to be substantial, placing a premium on automatic and man-in-the-loop data processing. In parallel, minimising the demands placed on information carriers and available bandwidth will be significant challenges in their own right.

Space precludes me discussing mission planning in any great detail, but we may need access to a fully interoperable mission planning and support architecture that hosts almost instantaneous re-routing and re-targeting functionality to enhance survivability, and enable delivery of effect against emerging and unplanned high value targets. Alternatively, the evolving HLOC is pointing in the direction of shared situational awareness lead-

ing to fewer requirements for traditional structured planning and which enables combat power at the tactical interface. Either way, there will be significant challenges here too.

We also face the challenge of de-risking some cutting edge technologies to ensure that they deliver on the promise already identified. UCAVs and air-launched UAVs figure highly here, and within the FOAS programme the mechanism of the Integrated Technology Acquisition Plan aims to ensure that these risks are properly understood and a road map to the higher Technology Readiness Levels is established. The integration of unmanned systems with manned platforms, and the necessary associated C2 structures, is also imperfectly understood currently, and we will need to assess soon where the possibilities and limitations of our various candidate systems really lie.

Finally, and crucially, offensive air power must be affordable. UK defence faces similar budgetary pressures to every other developed nation, and any system or capability that now attempts to justify itself on grounds of anything less than 'essential' will not stand scrutiny at the highest levels. We need to ensure that every pound we spend is spent wisely and the rigour we are applying to our associated research programme funding is testament to this. Our overriding challenge will be to deliver the critical capability required of FOAS against a backdrop of finite financial resources and competing claims of equally strong provenance. Squaring this circle will not be an easy task but it promises to be an incredibly stimulating one for those involved.

Conclusion

By its very nature, the unique ability of long range offensive air power to reach quickly and, if necessary, disrupt or destroy elements of an opponent's ability, will and means to sustain his aggression, potentially up to and including his strategic centre of gravity, will ensure that the maintenance of such a capability is likely to attract a very high priority for the UK for the foreseeable future. Moreover, air power's inherent flexibility and versatility should promote high confidence that investment in this agile capability will deliver significant dividends across the full spectrum of conflict.

Nevertheless, an unstable global security environment and the pace of technological advance, allied to the employment of non-linear strategies by both state and non-state actors, mandates that we must look increasingly far ahead if we are to continue to rely on our air power qualitative advantage as a central pillar of our defence capability. Inevitably, as resources become scarcer, this will be an increasingly hard discipline to maintain. Employment of astute balance of investment decisions that maximise our return by adopting innovative and synergistic systems of systems to deliver required capability is the only viable way ahead.

In doing so we must be careful to *build on* and *enhance* the core characteristics of air power and avoid the seductive trap of neutering them on the altar of programming savings. The FOAS programme has a flagship role to play in this new era. Continuing sensible and prudent investment in the pivotal military capability FOAS is being designed to deliver will ensure that long range offensive air power can continue to fulfil its essential roles and responsibilities in effects-based joint manoeuvre warfare well into the middle of the century. There is a clear risk that doing otherwise might subsequently come to be regarded as having been 'penny wise and pound foolish', and could invite a critical core capability gap for our successors that may one day leave them fatally exposed.

Notes:

[1] "The user requires a system of systems that provides the capability to create a range of effects on a balanced target set in the deep, including time sensitive targets, from extended reach, in all weather and light conditions, all terrain, in the highest threat environment and at a time of his choosing…." *Draft FOAS Initial Gate Business Case Single Statement of User Need, 08 Aug 03.*

[2] "The operational framework can be described in terms of *Deep*, *Close* and *Rear* operations, and is relevant in all categories of operations. It is a *conceptual framework*, used to describe how Deep, Close and Rear operations interrelate by *function* (what they are intended to achieve), within the battlespace (where they are to achieve it), and by time

Lt Col Prof Dr Dimitar Nedyalkov alongside a MiG-21

Moments in the Life of a MiG-21 Pilot

By Lieutenant Colonel Dimitar Nedyalkov

Certain instances in the experience of a combat pilot leave indelible marks in one's consciousness: critical situations he has encountered in flight (an environment God did not intend for humans) and his feelings at the first encounter with each successive aircraft type.

Speaking personally, the MiG-21 left, perhaps, the deepest such mark during my combat pilot's career. I do not ascribe this only to the 800 hours I went on to fly in various versions of this remarkable aircraft, but possibly to its authority — an authority that had emerged in the five wars and numerous conflicts this aircraft had seen before our first meeting.

It was in my first year after commissioning that I embarked on the MiG-21 theory course. By then I had accumulated over 350 hours on the Czechoslovak L-29 advanced jet trainer and on

subsonic Soviet MiG-15s and MiG-17s. Having flown in all weathers, by day and by night, and having practiced numerous dogfights, weapons firings and ground attacks, there was no need for me to feel apprehension regarding my flying skills. I had the confidence of a well-trained pilot, occupying the cockpit for each successive sortie with the ardour of all young men who have dedicated their lives to the grandiose idea of flight. Flying suited me.

Yet, as the ground technicians slid open the massive doors of the hangar housing the MiG-21s set aside for our training, I froze. The animated chatter among my 22-23-year-old colleagues halted. A machine of a completely different look to anything we had previously flown now faced us. Right away it impressed with its size, with its exacting shape, with the sheer impetus its designers had given it. Everything in it cried out for speed: the long cylindrical fuselage with its pointed nosecone and broad exhaust; the tiny, almost withered-looking wing; the conformal, rather sparingly glazed canopy.

I remember squaring up to the aircraft for some time, idly musing on whether I would manage. I had read much about its feats. We had studied combat experience and each of us recalled figures and facts. Like the 104 F-4 Phantoms downed in Vietnam against 57 MiGs in direct air-to-air combat. And like the 50-minute massed encounter overhead the Egyptian airfield of Mansoura where in 1973 fifty MiGs fought as many Phantoms, downing 18 of the latter at the cost of four of themselves, despite the American fighters' technological slickness and two-man crews. We recalled our future mount's excellent showing on the Syrian front in the same year, and its record against F-104 Starfighters in the Indo-Pakistani conflict. But we also recalled more experienced pilots warning us that, as distinct from anything we had flown prior to it, the MiG-21 was strict and unforgiving, especially at over 500 km/h (270 kt).

The Dove of Peace

My apprehension was reinforced after the first static cockpit sessions and simulator sorties. We had moved to the simulator after a month's theory,

I froze. The animated chatter among my 22-23-year-old colleagues halted. A machine of a completely different look to anything we had previously flown now faced us

Front and rear views of the twin-seat trainer MiG-21 Mongol

The design had suffered from Khrushchev's view that missiles were the thing of the future and any on-board artillery was an embarrassment

No MiG-21 pilot would forget the butterflies in the stomach occasioned by the thin needle's rapid march towards the red line

Lieutenant Colonel Dimitar Nedyalkov

The seat may have been height-adjustable, but this was of no benefit to a man of my ample height and the view ahead augured well for strict reliance on instruments in flight

to start building up habits. The version to which we were converting was the MiG-21PFM, often called the Dove of Peace by Bulgarian fighter pilots. The nickname was justified by the paucity of armament on the subtype: two R-3S infrared-guided air-to-air missiles. The design had suffered from Khrushchev's view that missiles were the thing of the future and any on-board artillery was an embarrassment. But the aircraft was seen as an excellent platform for the training of young pilots.

MiG-17 experience had forewarned me to expect Spartan cockpits in Soviet fighters, and reality did not disappoint. After all, Spartan or not, this was a second-generation jet fighter with superior avionics, good cockpit lighting for night flying, the sure-fire KM-1 ejection seat which would save the pilot at zero altitude and a speed range from 115 km/h all the way to 1,400 km/h (60 to 760 kt), and all the requisite altitude equipment.

The narrow cockpit with its haphazardly placed switches was no problem for us, but visibility definitely was. The seat may have been height-adjustable, but this was of no benefit to a man of my ample height — and the view ahead augured well for strict reliance on instruments in flight. In flight, attention would have to be apportioned in a new way. This observation is valid for all MiG-21 versions I subsequently flew, except the MiG-21F-13. This subtype's cockpit offered significantly better visibility, but at the expense of 50s-style instruments with ultraviolet lighting that turned night flying into a genuine trial.

Initial flights bore out my apprehensions. In fact, I may as well have been unconscious for my first sortie. Speeds were so much higher than on machines I had flown previously that my reflexes were way too slow. It seemed I had hardly departed and cleaned her up for the circuit before I had to dirty her up again and land. On approach the ground seemed not so much to rise as come up and hit me.

To be fair to myself, I ought to note that the MiG-21 departed and arrived at the record speeds of 360-380 km/h (195-205 kt) and 290-320 km/h (155-175 kt) respectively, depending on external stores and weight. Bulgarian pilots said that whoever learned to land the beast would land anything. The reason for such excessive speeds at these most demanding phases of flight was the wing's small area and poor high-lift devices. Apart from two-position (take off and landing) flaps, the aircraft featured upper wing blowing which made things tolerable and allowed stable flight at 340-360 km/h (185-195 kt). The system was fitted to all marks bar the MiG-21F-13. The latter landed in what was practically the emergency configuration for all other marks: airbrakes out and flaps set for take off, allowing the engine to work no harder than was acceptable.

High speeds and small wings made arrivals palpably hard, while excellent wheel brakes and the tail parachute reduced the landing run. Limited visibility hindered ground view in the flare only if the manoeuvre was initiated too high or was too steep. In these cases the intake completely obscured the runway, rendering directional control difficult in the instants before touchdown. That was why converting to the type called for (at the very least) an average level of skill from seconded pilots.

Impressive acceleration

Airborne, the aircraft also had its peculiarities. Acceleration was impressive: it is not surprising to me that all marks of MiG-21s can compete with fighters of subsequent generations in acceleration. Apart from easily picking up speed, the machine broke the sound barrier effortlessly, rapidly building up the M numbers. Though limited to M2.125, many of us trainee novices reached M2.5 through errors and poor thrust management: clearly, this was no problem for the airframe.

Gaining height after accelerating to M1.7 was no problem, either. Most of us reached the flight manual limit of 19,000 m (62,700 ft) in our initial stratospheric flights. Subsequently, we would occasionally boast of exploits in excess of 20,000 m (66,000 ft): an altitude where some machines' engines were better able to cope than others.

This performance by the MiG-21PFM afforded us successful practice intercepts and successful chases of targets flying at over 900 km/h (490 kt). Subsequent marks' performance was somewhat duller, while still good for the close-combat (or 'frontline') fighter class. Interceptor pilots were hampered by the RP-21 Saphir onboard radar with its 20-25 km (12-15 mile) range and 10-16 km (6-10 mile) intercept range for all marks, and the attendant need for ground vectoring. Near-misses with targets were frequent in training, rendered more serious by 600-800 km/h (325-435 kt) closing speeds and leading to the necessity to perform additional post-interception separation manoeuvres. This was never a favourite part of the sortie for us, because of its incredibly short duration.

That was why one of the most important dials in the cockpit was the fuel consumption gauge, its significance rising further when reheat was used. No MiG-21 pilot would forget the butterflies in the stomach occasioned by the thin needle's rapid march towards the red line. Even today I find the memory of the sight unsettling, despite my solid 'hourage' on combat types. The three drop tanks with their 490 litres (108 Imp Gal) each under the body and each wing, did not help much. While greatly limiting the already modest external stores, they extended combat radius by a modest margin, especially for low-altitude sorties.

Naturally, in the context of frontline fighters, close combat piloting technique was paramount. As could be deduced from the type's core task, it did not enjoy manoeuvrable flying, being in its element in high-altitude intercepts. However, it rolled stably at high speeds and climb gradients of up to 24 degrees. The most advantageous combat speeds lay in the 850-1000 km/h (460-540 kt) range. At critical alpha and speeds below stable roll minima, the airframe would shake. This was characteristic of all marks and served as due warning. The good thrust to weight ratio (0.85 with reheat and a warload of two AA missiles) allowed level combat with any contemporary fighter except the F-5.

Vertical aerobatics worked perfectly at alphas of up to 20 degrees, with preferred heights in the 200 to 5,000 m (600 to 15,000 ft) range. Above this, thrust was not always sufficient for confident

The machine broke the sound barrier effortlessly, rapidly building up the M numbers

juggling away from the enemy at the top of ordinary and Immelmann loops. Attention also had to be paid when descending, as the aircraft speeded up very rapidly and could easily go supersonic. This called for careful thrust management. Airbrakes were recommended when flying demi-tonneaux above 6,000 m (18,000 ft), to maintain normal flight when entering the dive.

Speeds below 500 km/h (270 kt) were considered undesirable in figure flying due to the machine's configuration. A drawback in figure flying was the engine's great thirst when in reheat. Normal aerobatic flight duration was not more than half an hour, this allowing sufficient reserves for going around or diverting if necessary.

'Subsonic chuckability'

As a sensation, flying the type was pleasant, with light stick loads at all speeds, with any excess load fully 'trimable'. The MiG-21F-13 was especially pleasant to fly semi-aerobatically and aerobatically, being devoid of any autopilot and radar. This made it rather light and imbued pilots with a sense of limitless 'subsonic chuckability' combined with high performance and faithful handling (the aircraft followed every tremor of the pilot's hand obediently and immediately). This fidelity eroded progressively with successive marks.

The instrument fit allowed complex manoeuvring in complex weather and at night (except with the MiG-21F-13). Horizon indication would often be lost momentarily at alphas above 110 degrees, but would presently return. However, horizon errors could accumulate in lengthy high-g vertical manoeuvres: a hazard to flying in cloud and at night without natural references. In such cases the narrow cockpit with its sparse glazing reduced the likelihood of loss of spatial awareness. Overall, awareness of aircraft attitude was rather strong in the MiG's cockpit.

The aircraft's prowess as a fighter did not extend to ground attack and recce. Limited cockpit visibility again increased the time needed to pinpoint ground targets. For the same reason, and also due to the nature of weapons used, it was recommended for ground attacks to be delivered from the dive. In this case the machine's good acceleration was a disadvantage, leaving far too short a time for the pilot to aim.

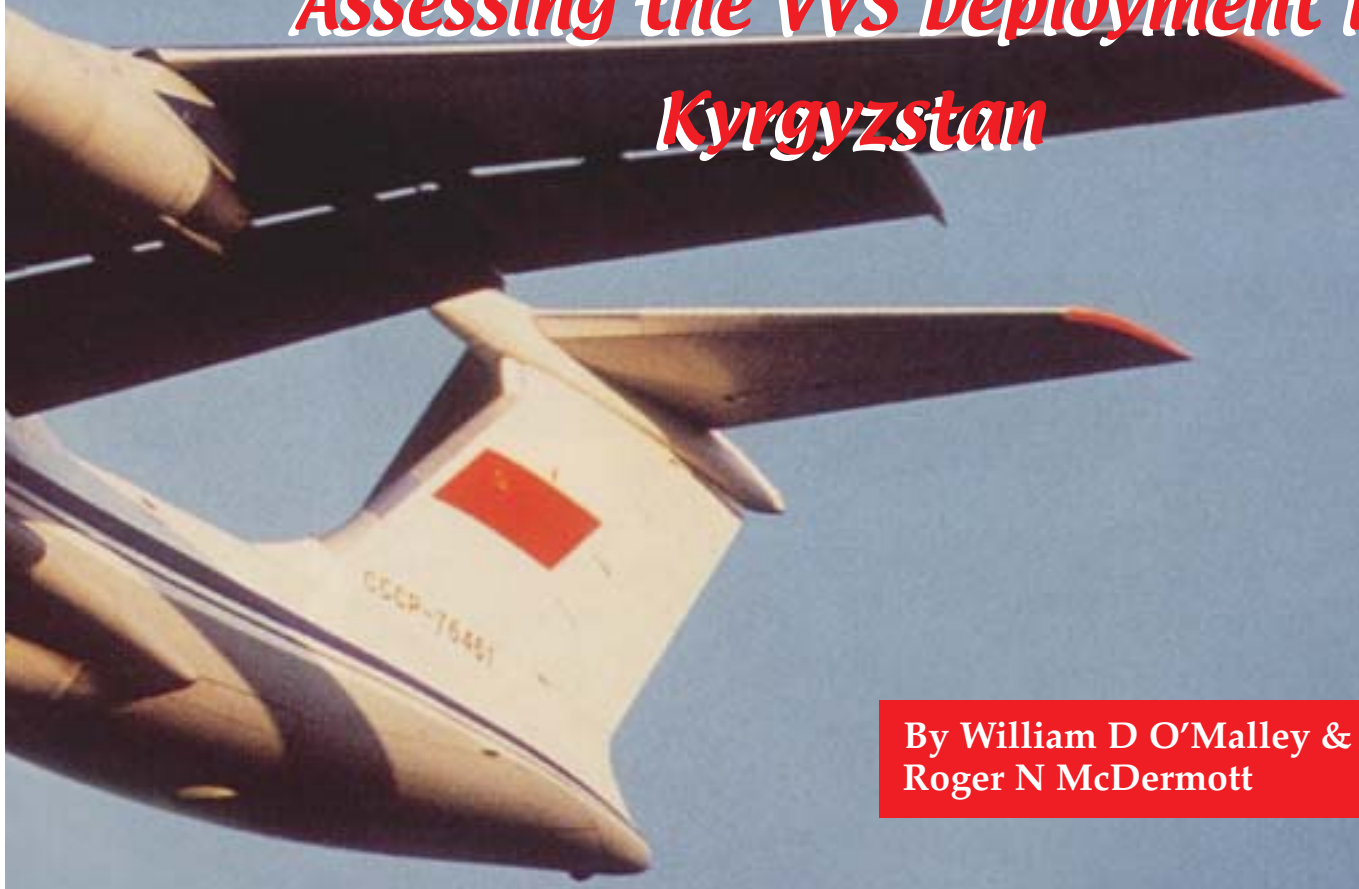
Despite these drawbacks, Bulgarian military pilots take pride in any MiG-21 hours in their logbooks: they attest to quality training and high attainment. Practice shows that type conversions are significantly easier after time spent in this aeroplane: a type that represents an era in world military aviation.

The MiG-21F-13 was especially pleasant to fly, being devoid of any autopilot and radar. This made it rather light and imbued pilots with a sense of limitless 'subsonic chuckability'

MiG-21F-13

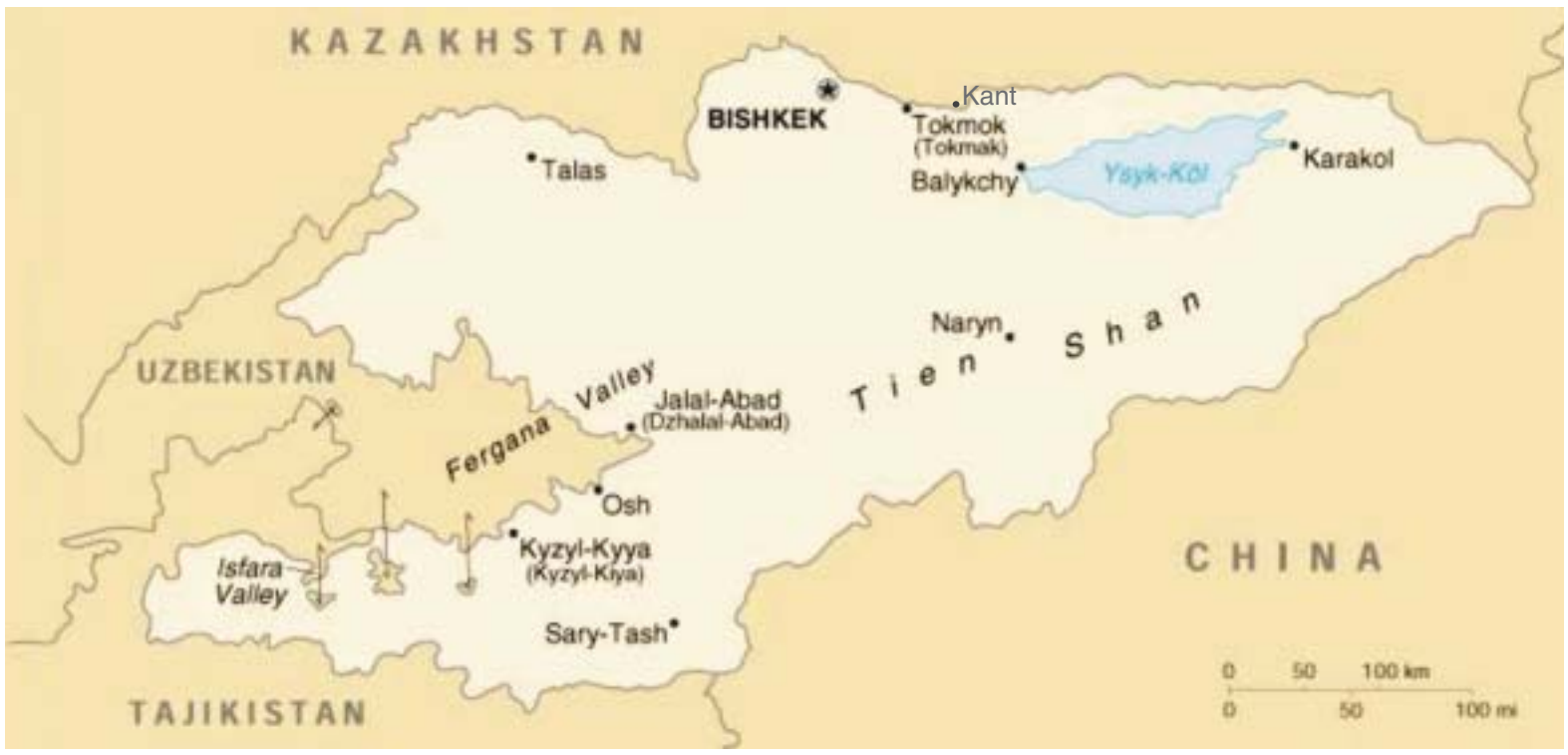
Russian Air Power in Central Asia:

Assessing the VVS Deployment in Kyrgyzstan



By William D O'Malley &
Roger N McDermott

In late November and early December 2002 the Russian Air Force (Voyenno-Vozdushnyye Sily — VVS) deployed Frontal Aviation and Military Transport Aviation aircraft to Kant airbase in Kyrgyzstan. The purpose of the trial deployment was ostensibly not to create a Russian base in Kyrgyzstan, but to develop a joint Russian-Kyrgyz operational military airbase to support the multinational Collective Rapid Deployment Forces (CRDF) that is established under the Collective Security Treaty (CST).1 One battalion from each member state (Russia, Kazakhstan, Kyrgyzstan and Tajikistan) are committed to the CRDF. In the following analysis we will examine the nature of the deployment and assess its military and geopolitical significance. First, it is essential to understand the main elements of the background to Kyrgyzstan's security challenges.



Deployment at Kant airbase

In April 2002, a meeting of the CST Security Council Secretaries first discussed the possibility of deploying Russian air power in support of the CRDF. The heads of the CST member countries agreed in October 2002 to approve a charter and agreement on the legal basis of the collective security treaty organisation, signalling a serious attempt to transform the regional body into an international security organisation. In due course, a decision on the CRDF was taken during a Moscow meeting of CST Defence Ministers on 20 November. Although the initial deployment was temporary in nature, plans have been proposed to form a permanent base at Kant in 2003. The timescale from first consideration to full implementation may take more than one year.[2]

US and other coalition air forces had been operating out of the Kyrgyz airfield at Manas into Afghanistan for several months, when Esen Topoyev, Kyrgyz Defence Minister, announced in late June 2002 that Kant would be made available for the CRDF; Kommersant in Moscow reported that it signalled the intention of the Kyrgyz government to re-enter the fold, reorienting its security needs toward Moscow as a prelude to asking the western forces to leave Manas.[3] Of course, it did no such thing, but the action demonstrated that Bishkek looks for multiple security partners, including the West, to support its own fragile security.

Initial Russian deployment

On 30 November 2002, components of Russia's VVS began arriving at Kant airfield in Kyrgyzstan. Initially two Su-25 fighters and two IL-76 cargo planes arrived at the military airfield.[4] Further air movements soon followed this high profile deployment that took place ahead of a meeting between Presidents Putin and Akayev in Bishkek. Between 30 November and 4 December 2002, three Su-27 fighters from Lipetsk,[5] two Su-25 attack planes from Dushanbe and two Il-76 military cargo planes constituted the total Russian deployment at Kant.[6]

Kant airfield

After the collapse of the Soviet Union, the Russian air force rapidly withdrew from its bases in Central Asia, leaving very little of value in Kyrgyzstan. Since the US deployment at Manas airbase in 2001 in support of Operation Enduring

Can Moscow find no other way of enhancing the anti-terrorist capabilities of its Central Asian allies other than committing itself to an experiment in the use of airpower?

Freedom, the choice of location for the CRDF airbase was limited to Bishkek, Dzhalal Abad, Isfar, Kant, Kyzyl-Kiya, Naryn, Osh, Przhevalsk and Tokmak.[7] The airfield at Kant was a former Soviet training base that was used to train foreign pilots. Throughout the 1990s, it stood as a stark reminder of the soviet era and fell into a poor state of repair. Nevertheless, since 2001 the Kyrgyz government has given priority to renovating the airfield,[8] which included renovation of the air traffic control building, construction of a new administrative building and putting the airstrip and main antenna in working order.[9] This airfield is ideally situated 20 km east of Bishkek, in a rural setting away from densely populated areas.

The November deployment of a small number of Russian aircraft to Kant, months ahead of the scheduled permanent deployment, was to evaluate the status and operational standards of the airfield. Lieutenant-General Alexander Zelin, Deputy Commander of the VVS, led a group of 70 air force experts to inspect the airbase infrastructure and barracks areas.[10] They reported to Moscow on the exact condition of the airfield and, given the airfields current shortcomings, there can be little doubt that Moscow will have to invest further money into upgrading its condition, if it is to house a permanent or even long-term Russian presence.

Kant was one of the deployment airfields offered to the US in support of Operation Enduring Freedom in 2001. An Air Force Survey Team inspected Kant along with the other proposed sites, preferring Manas. The Survey Team reportedly found that Kant airfield, which had been originally designed to support training operations and use by light training aircraft, was in poor condition and did not meet the US military's specific operational needs or safety standards.[11] For example, the runway slabs there are only 18 cm thick limiting the operational capabilities of the base; whilst it is ideal for the deployment of light fighters and transport planes of the kind envisaged by the Russian and Kyrgyz militaries — this runway could not support heavy, outsized strategic airlift or tanker aircraft like the C-5 or the KC-10/135.[12] It is currently able to support planes weighing a maximum of 200 tonnes.[13] Even beyond the runway further work is needed to bring this airfield up to operational standard, especially improvements in the navigation equipment necessary to aid the landing of Russian aircraft and the facilities to house its troops and equipment.

Sergei Ivanov, Russian Defence Minister, during his visit to Bishkek in early December 2002, dismissed as 'absolute rubbish' reports that the cost of renovating Kant could reach $300 million. Clearly, the exact figure and the cost to Russia will be the subject of bilateral negotiation. However, it is interesting to note that in the spring of 2002 the international coalition was considering expanding their use of Kyrgyz airfields in support of operations in Afghanistan. Western commanders considered using Tokmak airfield, 60 km east of Bishkek, but they rapidly dismissed it since it had fallen into disuse and disrepair following the collapse of the former Soviet Union. Muratbek Imanaliyev, Kyrgyz Foreign Minister, told parliament in April 2002 that Kant was also dismissed on the basis that its renovation would take a very long time at an estimated cost of $300 million.[14] Ivanov's reaction to the large cost figure [likely] reveals differences between Russian and Western standards in carrying out such work. Further modernisation of the infrastructure and technical features of the base will be required, though Moscow will attempt, no doubt, to minimise costs.[15]

The planned test deployment of the VVS assets to Kant was only partly successful, as the projected number of aircraft did not arrive, partly due to poor weather conditions. When the base is fully operational for the CRDF in 2003, plans are to station more than 20 Russian aircraft and 700 servicemen and civilian personnel there, for an unspecified time.[16] It is estimated that the cost of

Twelve years, generally poor maintenance practices, and limited access to critical spare parts calls into question the serviceability of many, if not most, of the airframes still in their inventory

The Kyrgyz air force operates 12 Hind attack helicopters

maintaining the airbase at Kant will reach $50 million per annum.[17] Such commitment necessarily demands analysis of the cost-benefit relationship. Can Moscow find no other way of enhancing the anti-terrorist capabilities of its Central Asian allies other than committing itself to an experiment in the use of airpower?

Kyrgyz Air Force

The Kyrgyz Air Force is the smallest of the country's armed services, with 2,400 personnel and a small number of operational aircraft. They inherited a fairly large fleet of older fixed- and rotor-winged aircraft from the Soviet Air Force units and the flight training school that were located in the Republic at transition. Twelve years, generally poor maintenance practices, and limited access to critical spare parts calls into question the serviceability of many, if not most, of the airframes still in their inventory.[18] Moreover, the avionic, electronic, navigation, communications and weapons packages on board most of these aircraft are now obsolete and in need of modernisation, if they are expected to perform just about any of the mission requirements routinely tasked to current generation aircraft. The L-39 and the helicopters are the principal ground attack assets remaining in the force. The air force reports that it has a total of 52 combat aircraft and nine attack helicopters assigned to operational units. Given the age and original design of these airframes, they do not have the targeting systems, communication packages, or the capability to deliver the precision munitions that Russian pilots are using in Chechnya and clearly nothing equivalent to what the USAF is using in Afghanistan. Moreover, the Kyrgyz pilots do not have either the training opportunity or the combat experience necessary to refine their ground support techniques. They also do not have access to the timely intelligence and targeting information needed to effectively support these types of closely coordinated operations. Nor do they have the trained forward air controllers and equipment necessary to maintain communications with troops on the ground and to effectively control the final approach to target.

Reported structure and aircraft holdings of the Kyrgyz Air Force

Unit Type	Equipment
Fighter regiment (1)	4 L-39 and 48 MiG-21
Composite aviation regiment (1)	2 An-12 and 2 An-26
Helicopter regiment (1)	9 Mi-24 and 23 Mi-8
Aircraft in storage	2 Mi-23, 24 L-39 and 24 MiG-21

Source: *The Military Balance: 2002-2003*

Implications of the Russian Air Force deployment in Kyrgyzstan

Planned structure of the CRDF aviation group
Following the test deployment to Kant, the Russian and Kyrgyz governments are expected to conclude an agreement in 2003 on the permanent basing of a combined aviation group that will be used to support CRDF anti-terrorist or counter-insurgent operations.[19] Kyrgyz Defence Minister, Esen Topoyev, more clearly defined what he saw as the group's missions when he stated that the aviation group will have two tasks: 'One is purely on the united air-defence system, which includes Su-27 aircraft, and the other is on supporting land forces. These are army aviation, or attack planes, as we call them, which are Su-25s, and they will be deployed here starting next year'.[20] Unspoken, but hopefully included as third and fourth mission requirements of the Russian air force element will be: expanding the training level and operational experience of the Kyrgyz pilots and providing a base facility for repairing and/or upgrading the readiness and capabilities of the Kyrgyz air force's aircraft. These latter two missions are extremely important, if the Russians are indeed looking to improve the Kyrgyz military's combat capability. Since the Kyrgyz air force is comparatively weak and its personnel poorly trained, the majority of the aviation group will consist of VVS fighters and transport planes. Current reporting indicates that the aviation group will include only Russian and Kyrgyz assets and be configured as outlined below.

CRDF aviation group[21]

Russian Air Force

Type	Role	Quantity
Su-25	Attack	5
Su-27	Fighter	5
An-26	Transport	2
IL-76	Transport	2
L-39	Trainer	5
Mi-8	Support	2

Kyryz Air Force

Type	Role	Quantity
L-39	Trainer	4
Mi-8	Support	2
An-26	Transport	1

Source: Sokut, 'We Will Threaten Terrorists'.

Major-General Vladimir Varfolomeyev, Russian Defence Attaché in Bishkek, expects the Su-27 (NATO designation Flanker) and Su-25 (Frogfoot) aircraft to be deployed to Kant from neighbouring Dushanbe.[22] The only Kyrgyz combat aircraft reportedly assigned to the CRDF Aviation Group to this point are the L-39 retrofitted trainer and multi-role Mi-8 helicopters.

Role and capabilities of designated aircraft
The Su-27 fighter, like the US F-15 and F-14, is designed for gaining air supremacy and supporting air operations. It is also capable of operating up to 1,600 km from its base, allowing it to operate from bases further from the target and crisis zone than the other deployed aircraft. The Kyrgyz have no comparable aircraft and its role likely would be to protect Bishkek from aerial attack, intercepting separate targets in Kyrgyz and Tajik airspace and escorting cargo or passenger planes.[23] In Chechnya, the Su-27 is more frequently used to attack ground targets with special and precision munitions and

The Su-25 appears to be well suited to attack targets in the rugged and mountainous parts of Kyrgyzstan, Tajikistan and Uzbekistan, where the insurgent bands generally operate

would likely perform a similar role with the CRDF.

Like the US A-10, the Su-25 was specifically designed as a ground attack aircraft, getting its first combat exposure in Soviet operations in Afghanistan. The lessons from this conflict against guerrilla forces like the Mujahadin and the Chechens resulted in many improvements in both this aircraft that has played a principal role in both Chechnya I and II and the tactics for its employment. Both the Soviet and Russian air forces have found that it is ideal for direct troop support because of its relatively low-speed (sub-sonic), armoured underbelly, weapons mix and load, and day/night capabilities.[24] It is highly manoeuvrable and able to attack when there is limited space over the target. The Su-25 appears to be well suited to attack targets in the rugged and mountainous parts of Kyrgyzstan, Tajikistan and Uzbekistan, where the insurgent bands generally operate.

An-26 transport aircraft is designed for moving airborne assault forces and Special Forces, as well as carrying conventional troops and delivering weapons and supplies to the theatre of operations. Il-76 and An-26 will carry out theatre and tactical transportation duties, with the Mi-8 handling most of the tactical transportation, medevac and search and rescue operations.[25] Furthermore, the Mi-8 can be used effectively to enhance the mobility of ground subunits in addition to supplying battle-field firepower. The Mi-8 can also be configured as an airborne communication relay station to boost the communications range of the units in the field or in the critical role as a forward air controller platform, providing final targeting instructions to attacking aircraft.

The L-39 is used as a basic pilot training aircraft. It can, however, be re-equipped for use as a strike aircraft or light bomber, although it was not designed for combat missions and has only limited operational capabilities and nominal effectiveness in such a role.[26] Like the Mi-8, the L-39 can also be used as a forward air control aircraft.

If necessary, once the base is fully operational, further reinforcement could enhance Russian air-power. Clearly, these reinforcements [or others] can be either generated by changing operational needs or for political purposes, when a particular message is being conveyed.

In case of aggression against Kyrgyzstan or any member of the Collective Security Treaty, the air force unit will be employed for its direct purpose — to bomb and wipe out the enemy

Anti-terrorist capabilities of the aviation group
An assessment of the anti-terrorist function of the aviation group must also be based upon what the respective governments believe its purpose to be in addition to considering Russia's operational and tactical use of airpower in a similar operational context, i.e., Chechnya and earlier Afghanistan. First, the view of the Russian government could not be more clear: the aviation group is a lifeline for the CRDF, providing essential support for ground forces in combat operations against groups of international or regional terrorists operating within Central Asia. Politically it is intended to strengthen bilateral ties between Russia and Kyrgyzstan, promote stability through the Collective Security Treaty, demonstrate Russia's proactive military role in combating the region's terrorist threat, and reinvigorate Russia's security links with the Central Asian Republics. Sergei Ivanov made clear that the military purpose of the aviation component in the CRDF, in comments before a meeting between Putin and Akayev. In Ivanov's view 'In case of aggression against Kyrgyzstan or any member of the Collective Security Treaty,[27] the air force unit will be employed for its direct purpose — to bomb and wipe out the enemy — this is what the air force unit is being set up for'.[28] Indeed the security situation in Central Asia directly influences Russian security, thus the deployment meets Russia's own security needs as well.

Vladimir Putin shared this view, believing that by creating the aviation group it would add new capabilities to the CRDF, since its individual parts have been based in their respective territories and have thus been unable to rapidly deploy to a trouble spot during a crisis: the aviation group is intended to rectify that problem. Putin went on to say: 'Therefore the creation of an aviation group for the rapid-deployment forces of the Collective Security treaty with a permanent base at a Kyrgyz airfield puts a completely different complexion on these rapid-deployment forces. This means that, first, these rapid-deployment forces have powerful aviation support and, secondly, this means — our pilots have already landed and that these rapid-deployment forces have been provided with the capacities of transport aviation and the possibility of fast delivery of forces and cargoes to a specific region, including Bishkek, if needed'.[29] This is remarkable in as much as Putin implicitly admitted that until the deployment of Russian air-power the CRDF were far from mobile or able to respond rapidly to an emergency situation.

Putin's statement, however upbeat about the prospects for the CRDF and further cooperation with Bishkek, betrayed recognition of the imperfection of the CRDF. More than one year after its creation Vladimir Rushailo, Secretary of the Russian Security Council, removed all doubt. During a meeting with President Akayev, he confirmed the need to bolster the CST and strengthen security cooperation between the two states, yet he went further than Putin in stating that the deployment of the VVS to Kyrgyzstan marked the creation of the CRDF — a military body first set up in 2001.[30] In reality of course, the CRDF remained a largely paper force even after its much publicised creation in 2001, as it still lacked a credible military capability. Given the geographical problems of deploying ground forces in the mountainous Central Asian region, especially in areas such as the Ferghana Valley, where the overland transport routes are underdeveloped, the CRDF lacked any teeth without the air assets necessary to move troops, supplies and firepower where needed quickly. Each of the Central Asian signatories to the CST CRDF (Kazakhstan, Kyrgyzstan and Tajikistan), with few viable security alternatives, were forced to publicly support the CRDF as both a deterrence and an effective anti-terrorist force, much in the style of the 'Emperors New Clothes': no one dared to point out the obvious failings of the security structure. It is inexplicable as to why Moscow refused to deploy an air component in support of the CRDF at an earlier stage, particularly as Rushailo has suggested that there is an impotent preventative dimension to the force.[31]

Tactics
During the first Chechen campaign (1994-96), the VVS is generally recognized to have performed poorly. It inflicted a great deal of collateral damage (on both the civilian population and its own troops), largely due to the absence of reliable target identification, the heavy use of free fall and unguided munitions, and the very limited use of precision weapons. Precision-guided munitions

In reality, airpower has a limited and predominantly supporting role to play in anti-terrorist operations

were only utilised during 2.3% of sorties flown.[32] Whilst Russia does not possess all-weather precision weapons, the weather also hampered operations, masking the target and restricting the effective employment of earlier generation precision munitions. Although the second Chechen campaign (1999-present) witnessed an improvement in Russia's use of airpower, problems persisted based on the underlying ailments of the VVS; most air operations were conducted in daylight and were again dependent on the weather, 'dumb bombs' continued to be the principal type of munitions used, and as the pockets of Chechen fighters reduced, so too did the combat effectiveness of airpower — as it was relegated more and more to the support role.[33]

The Russian military has used airpower in both Chechen conflicts without achieving a convincing demonstration of its utility against terrorists. In reality, airpower has a limited and predominantly supporting role to play in anti-terrorist operations. It has utility but it is most effective when used in concert with ground troops that concentrate enemy forces, provide clear target data/ID, and vector in the air, as demonstrated by the US Air Force in Afghanistan.[34]

The tactics employed by the VVS did change in the second Chechen campaign, and this provides some insight into the type of aircraft and possible tactics in mind for the air group deployed in support of the CRDF. Helicopter aviation provided critical support, particularly Mi-8 and Mi-24 helicopters that were used to move troops around the battlefield, provide fire support to the operation, and ensure the flow of supplies to the troops in the field. Based on operations both in Afghanistan and Chechnya, the military soon learned that helicopter lift decreases and fuel consumption increases when operating in a mountainous environment, a fact that was all too often overlooked in the planing phase.[35]

Aviation tactical groups (ATG) operating in the second Chechen campaign used Mi-8 (one or two) and Mi-24 (two to four) in support of company, battalion and regimental tactical groups. Within the ATGs, Mi-8s would direct Mi-24s to their targets. Mi-24s were also used in 'free hunt' operations, going after rebel formations and suppressing rebel positions. Su-25 ground attack aircraft and Mi-24 attack helicopters provided cover for the Mi-8 whilst the latter transported ground forces, or supplied stores, including food, water, fuel and ammunition, to the units operating in the mountains.[36]

During the Second Chechen Campaign, problems relating to the condition of the VVS continued to affect operations. Amongst these was the poor readiness of many of its units and their aircraft;

The Su-25 does not signal its approach like the heavy attack helicopter does and can effectively pass over enemy troops at 200 feet before they have an opportunity to react

There remain open questions as to exactly what role Russian airpower will play and will it have an impact upon the regional terrorist groups

inadequate intelligence preparation of the battlefield; shortcomings of reconnaissance in monitoring the build up of rebels and accurately reporting damage assessments of attacks on them; leading to the development of generally poor and/or outdated target lists. Pilots navigated visually and used non-secure radios permitting Chechen rebels to monitor their frequencies. Such failings help to explain the accidental bombing of the Georgian town of Zelo-Omalo by a Su-25.[37]

The Mi-24, used so frequently in the Chechen conflict, is notably absent from the planned deployment to Kant. Since the Chechen model has only limited application in the Central Asian region, one can only suggest that the aviation group would be primarily used for supporting ground forces, moving them to where they are urgently needed, as well as psychological operations (harassing the enemy). In the absence of the Mi-24, the supporting cover for the Mi-8s tactical transport missions would be from the Su-25. Russian experience with the Mi-24 helicopter and the Su-25 ground-attack aircraft in both Afghanistan and Chechnya indicates that the fixed-wing aircraft is nearly as efficient in the low intensity combat environment and is less vulnerable than the helicopter. Moreover, the Su-25 does not signal its approach like the heavy attack helicopter does and can effectively pass over enemy troops at 200 feet before they have an opportunity to react.[38] The Su-25 can also operate with the subsonic Kyrgyz L-39 fixed-wing aircraft much better than can the Mi-24. The success of any air operations will depend upon good to excellent intelligence (especially tactical intelligence), which is not something that the Kyrgyz are reputed to possess. Topoyev has said that the two Kyrgyz Mi-8 helicopters would be used for search and rescue (and medevac) operations. The Kyrgyz aviation is also expected to perform reconnaissance, and carry out transport duties.[39]

Future concerns

Statements made by the Russian leadership betrayed two things most clearly. First, despite the official denials, the CRDF was not an effective anti-terrorist body from its inception to the time of the deployment of Russian airpower in support of the force. Secondly, the actual deployment of the aviation group in 2003 demonstrates that Moscow has qualitatively raised its expectations of the anti-terrorist purpose of the CRDF and suggests that it intends to make good its commitment to the security of the southern CIS region, which it views as an intrinsic part of its own security interests.

In fact, there is near-unanimity in Moscow and Bishkek concerning the implications of the aviation support for the CRDF. President Akayev, after signing a new security cooperation agreement with President Putin in Bishkek on 5 December 2002, commented on the implications of Russian air support for the CRDF:

We believe this is exactly the specific realisation of the aims of the collective rapid-deployment forces. This will also be a certain, powerful security umbrella for Kyrgyzstan. We are now happy that our military airport in Kant has revived and very modern Russian fighters are flying over it.[40]

Nevertheless, there remain open questions as to exactly what role Russian airpower will play and whether it will have an impact upon the regional terrorist groups. Is the Russian package too small, especially in the number of ground support aircraft, to meet probable security needs? Moscow must demonstrate a willingness to expand the air package in response to evolving threat demands. The military thinking that underpins the creation of the CRDF and its support by aviation seems linked to the conviction that conventional military power is an effective anti-terrorist force. Russia's experience confronting the Chechen guerrillas has provided some experience in both the use and limits of airpower. Similarly, the Kyrgyz memory of the Batken campaigns highlight their own shortfalls and the need for improved combat capabilities, as noted earlier. But whilst airpower can be effectively utilised in destroying armed formations, such as the pockets of Chechen or Taliban guerrillas, it cannot be used to effectively pursue terrorists into urban areas where they can hide

As an anti-terrorist force aviation is of limited value as has been demonstrated in the history of recent conflict. After the initial use of the US air force in Afghanistan it required the follow up of Special Forces on the ground

amongst the civilian population. The most likely use of the air component of the CRDF is to move troops and supplies quickly to the theatre of operations or from place to place within it, which is best done by helicopter.

Rather than using the VVS to destroy bridges, mine roads and cut off supply and retreat routes to armed terrorists, it makes more sense to go after them directly using Special Forces — supported by aviation — not aviation alone. What kind of anti-terrorist operation is the VVS intended to support? If it is aimed against the IMU, making an incursion similar to those of 1999 and 2000 in the Batken, then conceivably the use of airpower could play a critical part. However, the initiative lies in the hands of the sub-state groups: they will determine the course and purpose of their own actions and may not conform to past practices. Furthermore, Rushailo's belief in the preventative dimension of the force ignores the Kyrgyz experience of the Batken when they drew back from using airpower because the terrorists had seized hostages.

Russian airpower and its performance in anti-terrorist operations is also open to question. Similar problems afflicting the Russian military, such as indiscipline, low morale and personnel problems plague the VVS. Crucially, the VVS is undermined by lack of finance and its combat readiness is further lowered by fuel shortages and the lack of flight training of its pilots, averaging 20 hours' flying time per annum, in stark contrast to the 150 hours more common in the Soviet air force or the NATO standard of 180 hours. These conditions are not expected by analysts to markedly improve within the next decade.[41]

Possible weaknesses that would require rectifying, if the aviation group is to prove effective in Central Asia:

- Altered operational tactics to suit the Central Asian region.
- Enhanced intelligence-gathering, a more responsive targeting process, and speed of implementation.
- Well trained pilots that are able to operate at night.
- Defence countermeasures against shoulder launched AAMs.
- A lack of trained Kyrgyz Forward Air Controllers and their support equipment for deployment with ground units or to operate in the air.

For many Russians and their allies, Putin's action was in contravention of one of Russian military doctrine's key principles by allowing an outside party to establish military presence in or an alliance with a member of CIS, especially the US

As an anti-terrorist force, aviation operating alone is of limited value, as has been demonstrated in the history of recent conflict. After the initial use of the US air force in Afghanistan it required the follow up of Special Forces on the ground. Terrorist tactics can also influence the decision on whether the use of airpower is appropriate, as witnessed during the Batken campaign in 1999; militants were avoiding being brought to battle and timing their operations to coincide with poor weather conditions or nightfall.

Bishkek's security tightrope

Clearly, the security environment has changed markedly following the chain of tragic events that brought US troops into Kyrgyzstan and resulted in the defeat of the Taliban and occupation of Afghanistan, and damage to the infrastructure of several terrorist organisations, including the IMU. But the war itself did not stabilise Bishkek's security environment, nor did it 'alter many basic long-term trends in the region' that will affect the role of the major players, especially the outsider — the US. The political and security environment will continue to both complicate US activities and colour Kyrgyz and broader regional perceptions of US moves and intentions.[42] Key players such as Russia and China, despite common desires for regional stability, undoubtedly will interpret US activity as an effort to gain hegemony in what they consider their backyard.

For Russia, the situation is much different, as it has long been a provider of markets and assistance, including security assistance, to Bishkek. But the nature and level of that support has been far below expectations. During the latter part of the Yeltsin presidency, the Central Asian states virtually fell off Moscow's foreign policy agenda and it was President Putin that scrambled to re-establish fruitful relations with these states, building on their common concern over the spread of fundamentalist-bred terrorism. Following 9/11, Putin offered Russian support for the war on terrorism, but more importantly for Bishkek, he raised no public opposition to the establishment of a US military presence in Central Asia. For many Russians and their allies, Putin's action was in contravention of one of Russian military doctrine's key principles by allowing an outside party to establish military presence in or an alliance with a member of CIS, especially the US.

Growing security concerns

Clearly the war in Afghanistan dealt a serious blow to the leadership of the IMU, but it did not entirely eliminate the threat, as drugs and other contraband from Afghanistan is still seeking an outlet to markets and transit through Kyrgyzstan, which remains a preferred option. Moreover, the tension between Kyrgyzstan and its neighbours, especially Uzbekistan, over border issues continues to escalate, with a battle over precious water resources not far removed. These developments are causing anxiety in Bishkek and prompted even President Akayev's strongest opponents to 'sup-

port his policy on broadening cooperation with Russia' and not placing too much dependence on the US to resolve the country's growing security concerns.[43] Ishenbal Kadyrbekov, leader of the opposition group in Parliament, underscored a concern for the unfamiliar ally, stating 'Recent events have convinced us that neither the US, China, nor any state other than Russia can become Kyrgyzstan's strategic partner. A range of historic, economic and other factors means only Russia can protect us from an external threat.'[44] Could this be construed as a call to evict US troops or does it reflect Bishkek's awareness of its own military limitations and its need to seek help wherever possible?

Notes:

1 'Russia Does Not Have an Aviation Base in Kyrgyzstan', Vremya Novostei, 26 December 2002, p5.

2 'US Ready to be "Junior Partner" in Central Asia', Izvestia, Moscow, 5 December 2002; 'Russian Aircraft Group in Kyrgyzstan to Repel "Terrorist" Attacks', Interfax, Moscow, 1607 GMT, 4 December 2002; Sergei Sokut, 'We Will Threaten Terrorists from Bishkek', Nezavisimoye Voyennoye Obozrenie, 6 December 2002, pp1, 3.

3 Dmitry Glumskov, 'Kyrgyzstan Will Shelter CIS Collective Forces', Kommersant, 2 July 2002, p 6.

4 'Russia Deploys Combat Aircraft in Kyrgyzstan', Interfax, Moscow, 0940 GMT, 30 November 2002.

5 Lipetsk Air Base is home to the 968th Research Training Mixed Air Regiment in Russia.

6 Sergei Sokut, 'We Will Threaten Terrorists'.

7 Amongst these airfields, only Bishkek has a runway of 9,000 feet or greater.

8 The Soviet Air Force literally stripped Kant Air Base clean when they withdrew. The Kyrgyz Armed Forces maintained a caretaker team at the airfield after the transfer of control to preclude any further damage. Their contingent to the Central Asian Peacekeeping Battalion was also stationed for a while at the airbase and assisted in its cleanup. The Kyrgyz were for many years trying to entice the Russian Air Force to lease the base and use it once again as a training facility.

9 'Kyrgyz Airfield Said Ready for Deployment of Collective Forces', Vecherniy Bishkek, 9 December 2002.

10 'Kyrgyz Defence Minister: Military Airfield Fully Meets Russia's Requirements', Interfax-AVN, Moscow, 0919 GMT, 9 December 2002.

11 One of the principal concerns about using Kant AB was that the airstrip would not hold up to the anticipated operational tempo (OPTEMPO), especially given the size and weight of many of the key support aircraft being deployed. Manas was selected for a number of reasons, to include: (1) it was up and operating as the country's international airport and it could effectively support an immediate deployment; (2) as an international airport, its runway, navigation, and communication systems were readily compatible with the deploying air units; (3) U.S. strategic lifters and tankers would be necessary to support the deployment and sustainment of Western air assets and runways in excess of 10,000 feet are preferred – only Manas among the proposed sites had the preferred runway length; (4) cargo aircraft require hard surface ramp space to unload and load, be serviced, and park – Manas is one of the few airfields in country that had sufficient square feet of ramp space to meet anticipated needs. For details on Air Force deployment planning factors see Chapter One, William D. O'Malley, Evaluating Possible Airfield Deployment Options: Middle East Contingencies, Santa Monica: RAND, 2001.

12 There are three sections to the airstrip at Kant. One is paved with asphalt, another is unpaved and the third with 500 concrete slabs, recently replaced as part of the Kyrgyz 'reconstruction' of the base; Yekaterina Grigoryeva & Dmitry Litovkin, 'Security Council Secretaries Determine Preventative Measures', Izvestia, 11 December 2002, p2.

13 'Russian Facility in Kyrgyzstan Not an Airbase, Military Attaché Says', Interfax, Moscow, 1212 GMT, 25 December 2002.

14 'Russian Planes in Kyrgyzstan Attached to Collective Security Treaty', Interfax, Moscow, 1151 GMT, 2 December 2002; 'Kyrgyzstan: Anti-terrorist Force Commanders Consider Using Other Kyrgyz Airfields', ITAR-TASS, Moscow, 1235 GMT, FBIS-SOV-2002-0401, 1 April 2002.

15 The relative costs for renovation should be different because the U.S. and Russia were looking at the installation to fulfil very dissimilar missions, house a very different mix of aircraft, and support operational tempo(s) that are miles apart. U.S. requirements require much more from the airfield and would require more time to upgrade accordingly and at a higher cost.

16 According to Kyrgyz Defence Minister, Esen Topoyev, 'the Russian airbase at Kant will be permanent and will be gradually expanded'. Zamira Eshanova, 'Central Asia: Diplomatic Visits Highlight U.S., Russian Competition,' RFE/RL Newsline, 3 December 2002, www.rferl.org/nca/features/2002/12/03122002190915.asp.

17 'Kyrgyz Airbase Seen as "Counterweight" to NATOs Manas', Nezavisimaya Gazeta, 5 December 2002; 'Russia Deploys Combat Aircraft'; 'Russian Warplanes Arrive at Kyrgyz Base', TVS, Moscow, 1200 GMT, BBC Monitoring Service, 1 December 2002.

18 By 1997, the local press was reporting that the air force was on

the verge of collapse, as no training and few maintenance facilities were operating. Reporting further indicated that only a handful of the L-39 trainers they inherited were still operational in 1998 and the same was being said for less than 50 percent of their helicopters. Markus and Abasov, 'Kyrgyzstan: In Search of a Regional Security System', pp. 542-543.

19 'Russian Defence Minister on Plans to Base Russian Warplanes in Kyrgyzstan', Channel One TV, Moscow, 1200 GMT, BBC Monitoring Service, 5 December 2002.

20 Eshanova, 'Central Asia: Diplomatic Visits Highlight U.S., Russian Competition'.

21 Sokut, 'We Will Threaten Terrorists'.

22 'Russian Planes in Kyrgyzstan Attached to Collective Security Treaty', Interfax, Bishkek, 1151 GMT, FBIS-SOV-2002-1203, 3 December 2002. Before this proposed deployment to Kyrgyzstan, Russia retained its only permanent Central Asian military presence in Tajikistan. It is interesting to note that in September 2000, the aviation regiment that had been long stationed in Dushanbe was reduced to an aviation group similar in composition to that proposed for Kant. Michael Jasinski, Russian Military Capabilities in Central Asia, Monterey Institute of International Studies, 17 September 2001, cns.miis.edu/research/wtc01/rus-mil.htm.

23 Ibid; 'Russian Aircraft Arrive in Kyrgyzstan to Beef Up Collective Force', Slovo Kyrgyzstana, Bishkek, 5 December 2002.

24 The cockpit is almost surrounded by 17mm of titanium armour, which deflects small arms fire and even 20mm rounds. Timothy L. Thomas, 'Air Operations in Low Intensity Conflict: The Case of Chechnya,' originally published in Air Power Journal, Winter 1997, found on the Foreign Military Studies Office website: fmso.leavenworth.army.mil/fmsopubs/issues/chechnya.htm.

25 The initial Kyrgyz operations against the IMU suffered greatly from a lack of helicopter support for the movement of supplies to troops in the field, the medevac of the wounded, as well as the timely movement of troops and firepower from one area to another in response to operational needs.

26 Jasinski, Russian Military Capabilities in Central Asia and 'Russian Aircraft Arrive in Kyrgyzstan to Beef Up Collective Force', Slovo Kyrgyzstana.

27 Emphasis added by the authors.

28 'Russia: Air Force Unit in Kyrgyzstan to Serve Collective Security Treaty Members', Interfax, Bishkek, 5 December 2002.

29 'Russian President Comments on Military Cooperation with Kyrgyzstan, Role of CIS', Radio Mayak, Moscow, 1500 GMT, BBC Monitoring Service, 5 December 2002.

30 'Kyrgyzstan: Collective Security Treaty Meeting to Discuss Fighting Organised Crime', ITAR-TASS, Moscow, 1324 GMT, 10 December 2002.

31 Ella Taranova & Igor Shestakov, 'Vladimir Rushailo: Prevention at the Planning Stage', Rossiyskaya Gazeta, 25 December 2002, p. 9.

32 See: Stéphane Lefebvre, 'The Reform of the Russian Air Force', Roger N. McDermott & Anne C. Aldis (eds), Russian Military Reform 1992-2002, Frank Cass: London, 2003 (forthcoming).

33 Ibid.

34 It is important to have a man in the loop that has a sense of the battlefield, provide updated target information to the incoming combat aircraft, rapidly address emerging targets, and provide battle management support to the combat pilot during the critical approach to the target. See, Glenn W. Goodman, Jr., 'Close Air Support: Air Strikes on Enemy Troops Remain "Trump Card" for Ground Force Commanders', Armed Forces Journal International, January 2002, p. 57 and John G. Roos, 'Turning Up the Heat,' Armed Forces Journal International, February 2002, pp. 36-42.

35 L W Grau, 'Technology and the Second Chechen Campaign: Not All New and Not That Much', Anne C Aldis (ed), The Second Chechen War, P31, June 2000, p107.

36 M. J. Orr, 'Better or Just Not so Bad? An Evaluation of Russian Combat Effectiveness in the Second Chechen War', The Second Chechen War, p94; Marcel de Haas, 'The Use of Russian Airpower in the Second Chechen War', Conference Paper, BISA, London, 16 December 2002.

37 Few Russian attack helicopters are equipped with Global Position Systems (GPS), which forces the pilots in Chechnya to depend heavily on visual navigation over often unfamiliar terrain. Benjamin S. Lambeth, The Continuing Crisis of Russian Air Power, Conference Paper, Air Power Symposium, Trondheim, 6-8 February 2001, p18.

38 Thomas, 'Air Operations in Low Intensity Conflict: The Case of Chechnya.'

39 'Kyrgyz Minister Says Some Russian Fighters to be Deployed Next Year', Public Educational Radio and TV, Bishkek, 1300 GMT, BBC Monitoring Service, 2 December 2002; 'Russian Aircraft Arrive in Kyrgyzstan to Beef Up Collective Force', Slovo Kyrgyzstana, Bishkek, 5 December 2002.

40 'Kyrgyz, Russian Leaders Praise Inter-State Relations, Pledge Cooperation', Kyrgyz Radio First Programme, Bishkek, 1500 GMT, BBC Monitoring Service, 5 December 2002.

41 See: Lefebvre, 'The Reform of the Russian Air Force'.

42 Rumer, 'Flashman's Revenge: Central Asia after September 11'.

43 Sultan Jumagulov, 'Kyrgyzstan Courting Russia,' IWPR's Reporting Central Asia, No. 185, February 21, 2003.

44 Ibid.

The Air and Space Nation is in Peril

By Colonel Philip S Meilinger

The function of the Army and Navy in any future war will be to support the dominant air arm.
(Gen James Doolittle)

This is a good news, bad news story. The United States is the world's first and only air and space nation. That fact is evidenced in our dominance of air and space technology and infrastructure, as well as in the future visions shared by our political, economic, military, and cultural leaders. This domination has important implications for our national security.

Unfortunately, many Americans have come to view air and space dominance as their birthright. It is not, and troubles are brewing, so we must take steps now to ensure our dominance in the future.

Americans have always looked to technology to ease their problems, so they took naturally and quickly to air and space power — the epitome of advanced technology. America was the birthplace of aviation, and it is now difficult to imagine life without our television satellites, cell phones,

76 *Since 1960 the number of airliners has quadrupled (and aircraft have more than doubled in size), while the size of the US merchant fleet has dropped 84 percent, a mere two percent of the world's total*

Internet, and air travel. Indeed, US airline passenger traffic has tripled over the past 25 years (*fig. 1*).

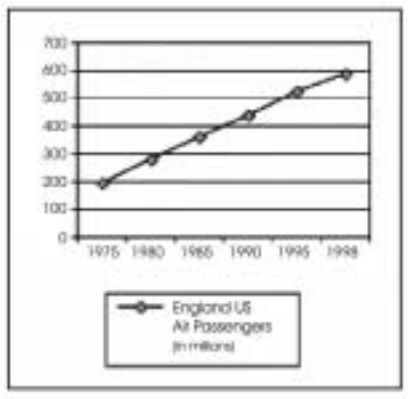


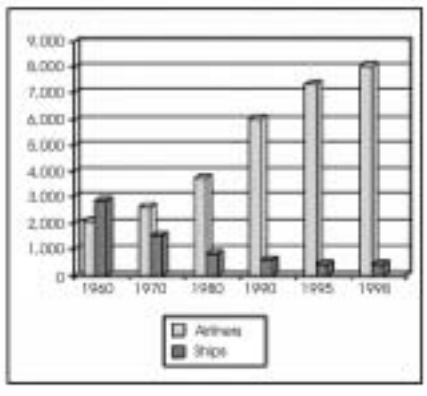
Figure 1. US air-passenger growth (From *National Transportation Statistics 2001,* 'US Air Carrier Aircraft Departures, Enplaned Revenue Passengers, and Enplaned Revenue Tons' [table 1-35], on-line, Internet, 17 January 2003, available from

http://www.bts.gov/publications/nts/index.html

Speed is the engine of commerce and economic growth. Rapid means of transportation have been essential for nations seeking economic dominance.

The rise of Britain in the 18th century was based on global trade carried by its large merchant fleet, which in turn was protected by the Royal Navy, the world's largest and most powerful. By the beginning of the twentieth century, the United States was also a maritime power, possessing a sizeable merchant fleet and navy.

As the 20th century progressed speed became synonymous with aircraft, and expanding American aviation began to push out the ship. Over the past 40 years, the growth of the US airline industry has been dramatic, in contrast to the decline of our shipping industry. Since 1960 the number of airliners has quadrupled (and aircraft have more than doubled in size), while the size of the US merchant fleet has dropped 84 percent, a mere two percent of the world's total (*fig. 2*).



It is ever more essential that the United States maintain strong public support for its actions. This in turn means we must be extremely careful about both inflicting and sustaining casualties

Figure 2. Airlines versus merchant ships (From *National Transportation Statistics 2001*, 'Number and Size of the US Flag Merchant Fleet and Its Share of the World Fleet' [table 1-20], on-line, Internet, 17 January 2003, available from http://www.bts.gov/publications/nts/index.html)

In addition, airport expansion is under way at many airports because airline passenger travel is expected to double over the next decade. As for cargo, 95 percent of the world's air-cargo capacity resides in Boeing airframes, and the value of goods shipped is telling. In 1997 the average pound of cargo travelling by boat was worth seven cents; by rail it was 10 cents, but by air it was $25.59. When Americans have something important and valuable to ship and it needs to get there quickly, they send it by air.

Air and space trade has significantly increased over the past several decades. In 1999 America's air and space industry contributed $259 billion to the nation's economy. The black ink in the air and space balance of trade rose to over $32 billion in 2000, making it the largest net exporter in the US economy (*fig. 3*). At the same time, the *overall* US trade balance has been negative for 27 of the past 30 years, and the deficit now exceeds $250 billion annually. Given these statistics, it is apparent that the United States has now become an air and space nation — indeed, *the* air and space nation.

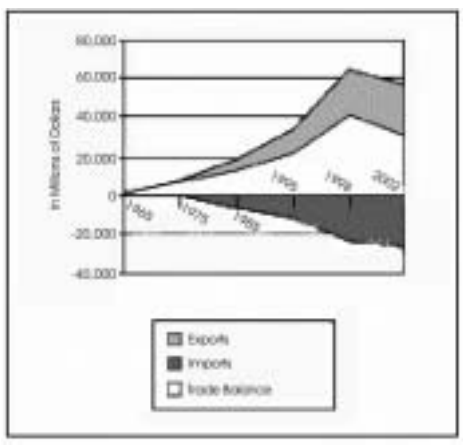


Figure 3. Air and Space Imports/Exports and Balance of Trade (From Aerospace Industries Association, *Year-End Review and Forecast*, 'Aerospace Balance of Trade' [table 6], on-line, Internet, 17 January 2003, available from http://www.aerospace.org/stats/yr_ender/tables/2002/table67_2002.pdf)

One must remember that America once led the world in other transportation technologies, but over the past two centuries, it has relinquished leads in railroads, shipbuilding and automaking. The US share of the world auto market, for example, has fallen from 48 percent to 15 percent over the past 40 years. We cannot allow our lead in air and space to evaporate similarly.

National security and air and space

Just as the Royal Navy defended British economic strength over a century ago, so do our air forces

protect our economic security. This is especially true because military strategy has evolved so dramatically over the past decade. The basic factors that shaped our geopolitical environment during the Cold War era have changed. The Soviet threat is gone, but other threats and other commitments remain. In fact, US military deployments have increased fourfold while the size of our military has shrunk by 40 percent. The character of these engagements has also altered. It is ever more essential that the United States maintain strong public support for its actions. This in turn means we must be extremely careful about both inflicting and sustaining casualties. Our military campaigns from the Persian Gulf War to Afghanistan have been marked by remarkably low losses, and the increasing use of precision weapons has limited civilian casualties and collateral damage, essential to maintaining worldwide public support.

It is obvious, however, that if such sterilized warfare is our goal, then certain types of strategies, tactics, and weapons are more desirable than others. Precision or non-lethal weapons delivered by air platforms — ideally either unmanned, unseen, or flying beyond the range of enemy fire — are the instruments of choice. To be sure, the process of identifying, tracking, and destroying mobile targets — tanks, trucks, and terrorists — remains one of our most difficult challenges, but this problem is being addressed through the use of a combination of space-, air-, and land-based sensors tied to strike aircraft by satellite.

It would be foolish for our leaders to think that air and space power could be effective in any crisis, but it has now become their weapon of first resort. The American people intuitively realize this: recent Gallup Polls reveal that 42 percent of those surveyed believe the Air Force is the most crucial arm of our national defense, and a like number believe it should be built up to a greater extent than the other services.

Just as our commercial air fleet is the largest and most modern in the world, so too is our military airpower. Our superiority is even greater than a comparison of the number of US military aircraft to the totals of other leading countries would indicate (*fig. 4*). Although China has a large supply of aircraft, most are obsolescent, including over 4,500 Vietnam-era MiG-17s, -19s, and -21s. Certainly, quantity has its own quality, but most of the Chinese air force would stand little chance against

Russia's air force has atrophied dramatically over the past decade. Once the pride of the Soviet state, much of this vaunted air force now sits unused

a frontline adversary. Similarly, Russia's air force has atrophied dramatically over the past decade. Once the pride of the Soviet state, much of this vaunted air force now sits unused.

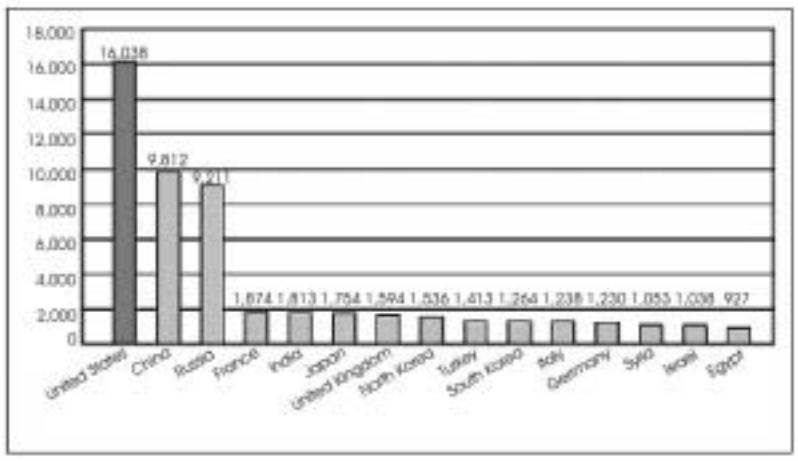


Figure 4. Leading nations in total airpower (From 'World Military Aircraft Inventory', *Aviation Week and Space Technology,* 13 January 2003, 257–76

Examining the *types* of military aircraft comprising the world's air forces is also revealing. The majority of combat aircraft worldwide consists of short-range fighter-bombers, such as the F-16, Mirage 2000, and MiG-21. The United States has nearly 4,000 such aircraft but has far more capability than that. Our airlift and aerial-tanker fleets allow us to project power anywhere in the world on short notice. The United States possesses the vast majority of the world's large military cargo aircraft such as the C-17 and C-5 while also having four times more tankers than the rest of the world combined. Tankers turn our tactical fighters into strategic bombers. No other nation has such an impressive capability to project power and influence. China, for example, has fewer than 50 modern cargo aircraft and virtually no aerial-refueling capability.

Our dominance in space is equally compelling. At present, approximately 550 operational satellites are in orbit. Nearly half of those were launched by the United States, and approximately 100 of them have military missions. In addition, the Global Positioning System's constellation of 28 satellites provides precise geographical data to users all over the world. In contrast, Russia now has only 90 operational spacecraft, and much of its space infrastructure — its missile-launch detection system, for example — is moribund. Although China can be expected to become a space competitor — it is currently working on an anti-satellite system — it has launched an average of fewer than four satellites per year over the past decade.

Over the past decade the Army has spent more on aircraft and missiles than it has on tracked combat vehicles

Warfare has changed. Stealth, precision weapons, and space-based communication and intelligence-gathering systems are examples of this new form of war

Within the US military services, one finds an increasing reliance and emphasis on air and space power. According to an old saying, if you want to know what's important, follow the money. In the American military, that trail is clear. The backbone of the Navy is the aircraft carrier, which costs over $5 billion each (without its aircraft and support ships), and the Navy spends nearly as much on aircraft each year as does the Air Force. The top funding priority of the Marine Corps is the tilt-rotor V-22 cargo plane, which will cost $85 million apiece. The Army has major production and modernization programs for Comanche, Apache, and Black Hawk helicopters that will total $70 billion. Over the past decade the Army has spent more on aircraft and missiles than it has on tracked combat vehicles. In sum, over 60 percent of the US defense budget is devoted to air and space forces. In fact, a comparison of our four air arms with those of the rest of the world shows that each *individually* is greater than the military air assets of most major countries (*fig. 5*). The qualitative superiority of American aircraft makes our air and space dominance even more profound.

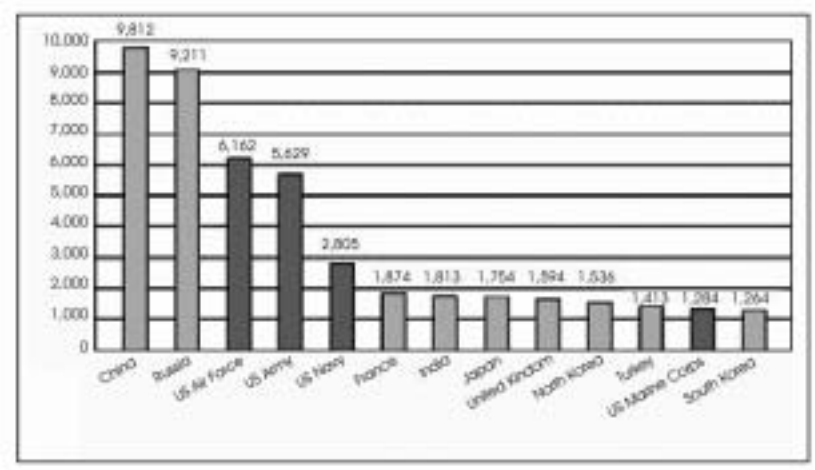


Figure 5. US airpower versus the world (From 'World Military Aircraft Inventory', *Aviation Week and Space Technology*, 13 January 2003, 257–76)

The reason for this emphasis on air and space power among our soldiers, sailors, and marines is their realization that military operations have little likelihood of success without it. It has become the American way of war. The major disagreements that occur among the services today generally concern the control and purpose of air and space assets. All of them covet those assets, but their differing views on the nature of war shape how they should be employed. Thus, we have debates regarding the authority of the joint force air component commander, the role of the corps commander in the deep battle, the question of which service should command space, and the question of whether the air or ground commander should control attack helicopters. All the services trumpet the importance of joint operations, and air and space power increasingly has become our primary joint weapon.

Air and space dominance also provides our civilian leadership with flexibility. Although intelligence is never perfect, our leaders now have unprecedented information regarding what military actions can or cannot accomplish and how much risk is involved in a given action. For example, our leaders understood far better than ever before how many aircraft and weapons would be needed over Serbia and Afghanistan to produce a specified military effect, weapon accuracy, collateral damage that might occur, and risk to our aircrews. This allowed our leaders to fine-tune the air

Less travel means fewer flights and aircraft sales are down, and nearly 300 civil cargo aircraft now sit in storage in the desert. Total cargo traffic worldwide fell an unprecedented 9.7 percent last year, billed the worst in the history of air transport

campaign, providing more rapid and effective control than previously.

Other factors affect the way we'll fight. One hears much talk today of 'transforming the military' to meet new threats. The Persian Gulf War, Bosnia, Kosovo, and Afghanistan — and, for that matter, Somalia and Haiti — indicate that traditional methods, weapons, forces, and strategy will often be inadvisable. Warfare has changed. Stealth, precision weapons, and space-based communication and intelligence-gathering systems are examples of this new form of war. Certainly, the human element in war can never be ignored. People make war, and all their strengths and weaknesses must be considered. Yet, it would be foolish not to exploit new technologies that remove part of the risk and human burden in war. It is not always necessary for people to suffer. Air and space power permits new types of strategies that make war on things rather than on people and that employ things rather than people. It capitalizes on the explosion in computer, electronic, and materials technologies that so characterize the modern era. This is America's strength — one that we must ensure.

Dangers ahead

The terrorist attacks of 11 September 2001 (9/11) served as a wake-up call. Problems simmering at or below the surface for several years have now burst forth. The shutdown of air traffic after 9/11 stranded thousands of travelers and disrupted business. Things are still far from normal. Perhaps the greatest challenge facing the air and space nation today is conceptual. Although Americans have become dependent upon air and space and although our uniformed leaders realize the domi nance of air and space power in military operations, they have yet to think through its implications or ways of maintaining its momentum.

Air and space power is not merely a collection of airplanes or spacecraft, although those assets are certainly essential. It is not even the combination of those machines with an effective command and control network and intelligence-gathering capabilities. Rather, air and space power is the totality of our military air and space assets from all the services; our commercial airline industry and the pilots and mechanics who comprise it; our commercial air and space industry with its thousands of engineers and designers; the massive airport and airways structure stretching across the nation and, indeed, the world; and our codified doctrine on how all this power should be employed. All of these facets are essential for the United States to remain the air and space nation.

One problem is a tendency to focus on individual services and weapons or specific airport and air-traffic-control problems, thus failing to see air and space power in the broadest sense. Attempts to look at parts of the problem — 'tactical' aircraft, airlift requirements, or air-traffic-control sequencing issues — are limited by their myopia. The tactical-air debate, for example, never discusses attack helicopters — their cost, vulnerability, or role in conjunction with fixed-wing air assets. Similarly, airlift requirements are tied to Army deployments that may or may not be relevant in the future. Questions remain to be asked. How does one measure the relative value of land-based versus sea-based airpower, or rotary versus fixed wing? What are the trade-offs between the use of air and space power versus ground troops or maritime forces? In an even broader sense, how do we articulate a vision

for all of our air and space assets, military and civilian? How do we ensure the viability and superiority of our industrial base and the competitiveness of our commercial airline companies?

Over the past few years, we have heard references to a 'crisis' in the American air and space industry. Despite America's dominant position, concerns need to be confronted. Funding cuts during the 1990s have left the Federal Aviation Administration (FAA) facing a backlog in modernizing equipment and software. Although its budget has recently been increased, most of the funding is going into security, not new air-traffic-control equipment. Our scientific and engineering force is graying: the average age of the US air and space worker is nearly 50 and over half of that force will be eligible to retire during the next six years. The profitability of airlines is down: they sustained huge losses in 2001 due largely to 9/11 and the subsequent requirement for expensive new security procedures. After the attack, passenger travel dropped 60 percent, and over 60,000 people have lost their jobs in the industry. Passenger loads are not expected to return to normal levels in the near term.

Less travel means fewer flights and aircraft sales are down, and nearly 300 civil cargo aircraft now sit in storage in the desert. Total cargo traffic worldwide fell an unprecedented 9.7 percent last year, billed the worst in the history of air transport. In space only 60 launches took place worldwide in 2001 — the lowest number since 1962 — and US commercial space exports were 75 percent below 1998 levels. Also, international competitors such as Airbus are garnering a greater market share of a field traditionally dominated by American legends such as Boeing, Lockheed Martin, and McDonnell-Douglas. Although Boeing is still the top air and space company in the world, its lead is shrinking, and the European Aeronautics Defence and Space Company has pushed Lockheed Martin out of the number two slot. Industry analysts continue to maintain that the long-term future of air and space is bright, but for the short term, major problems need to be addressed.

Spending on air and space research and development is down nearly 20 percent in the past decade, and the Bush administration has proposed cuts in research of $58 million at the National Aeronautics and Space Administration and $20 million at FAA for 2003. In addition, airline stocks are down; defense spending as a percentage of gross domestic product is three percent, a post–World War II low (*fig. 6*); employment in the US air and space industry has dropped by 600,000 people over the past decade (*fig. 7*); the US share of the world air and space market is down 20 percent over the past 15 years; the number of technology graduates seeking a career in air and space has fallen by 57 percent since 1990; and the air and space industry's net debt is up. US Airways recently declared bankruptcy, and United Airlines has announced that it might have to file for Chapter 11 as well. How can we reverse these trends?

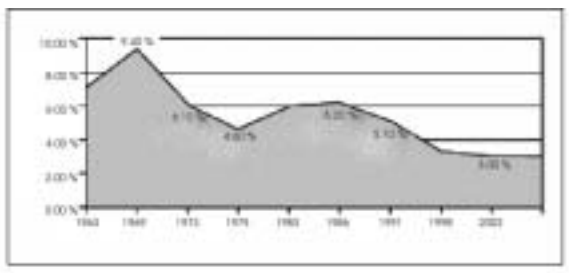


Figure 6. Defense outlays as a percent of gross domestic product (From Tamar A. Mehuron, 'The Defense Budget at a Glance', *Air Force Magazine*, September 2001, 78)

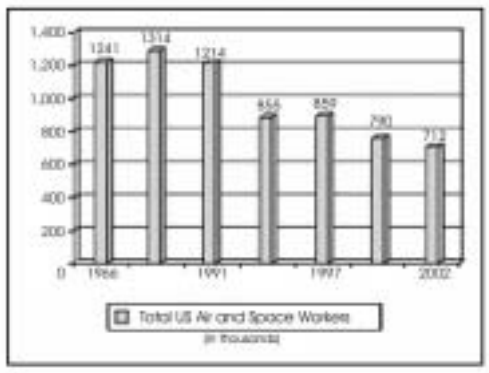


Figure 7. Employment in the US air and space industry (From Aerospace Industries Association,

The F/A-22, the Air Force's new air-superiority fighter, only recently received congressional approval for production. The F/A-22 was designed 20 years ago

Year-End Review and Forecast, 'Aerospace Related Employment' [*table 9*], on-line, Internet, 17 January 2003, available from http:// www.aia-aerospace.org/stats/yr_ender/tables/2002/tble09_2002.pdf)

First and foremost, we must conduct a broad-based examination of all aspects of the air and space nation. Congress took the first step by establishing the Commission on the Future of the United States Air and Space Industry. This blue-ribbon panel of industry and financial experts and former government officials was chartered to study the health of the air and space industry and infrastructure in the United States, both military and civilian , identify problems and propose solutions. Their final report was published in November 2002 and re-identified several problems and highlighted others. They noted, for example, that the World Trade Organization has come down

It is apparent that US foreign policy requires close relations with our allies. If we are to maintain the moral high ground, we cannot be seen as the 'Lone Ranger'

hard on the US air and space industry for 'illegal export subsidies' that, if uncorrected, will cost the United States over $4 billion in fines per year. At the same time, American corporations complain that European value-added taxes are a form of government subsidies that are unfair to the United States. These are the types of economic issues that need to be studies at the cabinet/congressional level. Partly as a result of the commission's findings, Sen George Allen (R-Va) and Sen Chris Dodd (D-Conn) have introduced legislation such as the Aeronautics Research and Development Revitalization Act of 2002 to help rectify some of the industry's problems.

Overcrowded airports and late departures are becoming endemic. Herb Kelleher, the retired head of Southwest Airlines, argues that a mere 'fifty miles of paved highway', essentially 30 new runways nationwide, will solve the airport overcrowding problem.[1] Even if his claim is true, it too easily ignores the task of building the ramps, terminals, parking garages, and so forth that must accompany the new runways. So the solution is not easy, given environmental concerns and debates over the use of valuable real estate. Nonetheless, it is important to realize that Kelleher's proposal would require someone with both vision and persistence to implement it. The American Institute of Aeronautics and Astronautics has called for presidential action, a commitment similar to that made by Dwight Eisenhower in the 1950s to build our national interstate highway system.

As for military air and space power, the problems are also daunting. Since taking office, Defense Secretary Donald Rumsfeld has laboured to transform his department. The results so far are mixed. It appears that the Army's Crusader artillery system is dead, but there is little else to show in the way of 'transformation' over the past 18 months. Part of this is due to the war on terrorism which has generated a large boost in defense spending. These funds, plus the necessary focus on the war itself, have tended to defer and blur action on needed changes. Indeed, debate continues as to the best way to fight this war and with what weapons and organisations. Unfortunately, serious systemic problems must be tackled, and they can't wait for things to quiet down.

For example, the F/A-22, the Air Force's new air-superiority fighter, only recently received congressional approval for production. The F/A-22 was designed 20 years ago. The weapons-acquisitions process is broken. Over the past decade, virtually all of the numerous studies on the organisation of the Department of Defense cite the need for acquisition reform. It has not yet happened. Thus, Congress commonly delays, stretches out, and reduces the number of weapons to be purchased-ostensibly in an effort to reduce costs. In reality, this practice creates havoc with the manufacturers, while also driving costs through the roof. For example, Congress originally authorized the purchase of 750 F-22s. Over the past several years, it has cut the planned buy to 295, and further cuts are being discussed. Testimony before Congress reveals that these cuts have raised the unit price of the F-22 by over $21 million. That's real money. Similarly, recent congressional action restructured the Army's Comanche program, cutting the number of helicopters to be purchased. Although this move 'saved' $10 billion, it raised the chopper's unit cost to a whopping $60 million. We cannot afford to have the air and space star hitched to a Model T acquisition system.

The other danger lies in the realm of grand strategy. It became clear during the Persian Gulf War and operations against Serbia that our air and space strength not only exceeded that of our adversaries, but also exceeded that of our allies.

The vast majority of some key air and space assets — stealth, precision munitions, electronic jammers, intelligence satellites, tankers, and strategic air-lifters — was provided by the United States. This made it very difficult to devise an effective and balanced air plan. Interoperability has been a goal of the North Atlantic Treaty Organisation (NATO) for decades, but it is now of even greater concern. If our strategy calls for increased reliance on air and space power and the continual quest for technological advances, this interoperability problem can only get worse.

At the same time, it is apparent that US foreign policy requires close relations with our allies. If we are to maintain the moral high ground, we cannot be seen as the 'Lone Ranger'. This was apparent in the aftermath of the 9/11 terrorist strikes. We must have the political top cover provided by either a formal alliance such as NATO or an *ad hoc* coalition, as existed during the Persian Gulf War. Clearly, the imperative to operate in an alliance/coalition will clash with our technical disparity relative to those allies. We must find a way to bridge this gap.

Conclusion

The United States is the world's first and only air and space nation. This is true for many reasons, but the most basic one is that we wished to be. We developed the technology, infrastructure, and mentality at great cost and effort to achieve our dominant status. The fact of this pre-eminent position is reflected in our political, economic, military and cultural lives. We must not take this dominance for granted. If we intend to maintain our position and make full use of the benefits that air and space power provides, then we must do certain things.

The United States must have a comprehensive plan to develop, improve, and coordinate the commercial and military aspects of our policy. We must stem the decline in our research and development efforts while rebuilding and expanding our air and space infrastructure and educational base. We must change the way we develop and buy our air and space technologies to take full advantage of new ideas and advances, ensuring that our equipment is not out of date before it is even fielded. At the same time, we must remember that we are part of a world community that looks to us for leadership. That means we need to cooperate, not dictate, and we must become true partners with our allies.

We must look closely at the fundamental principles and assumptions underpinning our military strategy and force structure. Too much of what our military does today is based on tradition. Old ideas and old ways may not work in the 21st century. Air and space power offers a cost-effective, rapid and discriminate weapon for our political leaders. Let us sharpen that weapon.

Note

[1] Herbert D. Kelleher, 'The Next Century of Flight', *Aviation Week and Space Technology,* 4 June 2001, 86.

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A 3 Squadron Henry Farman 20 comes in to land

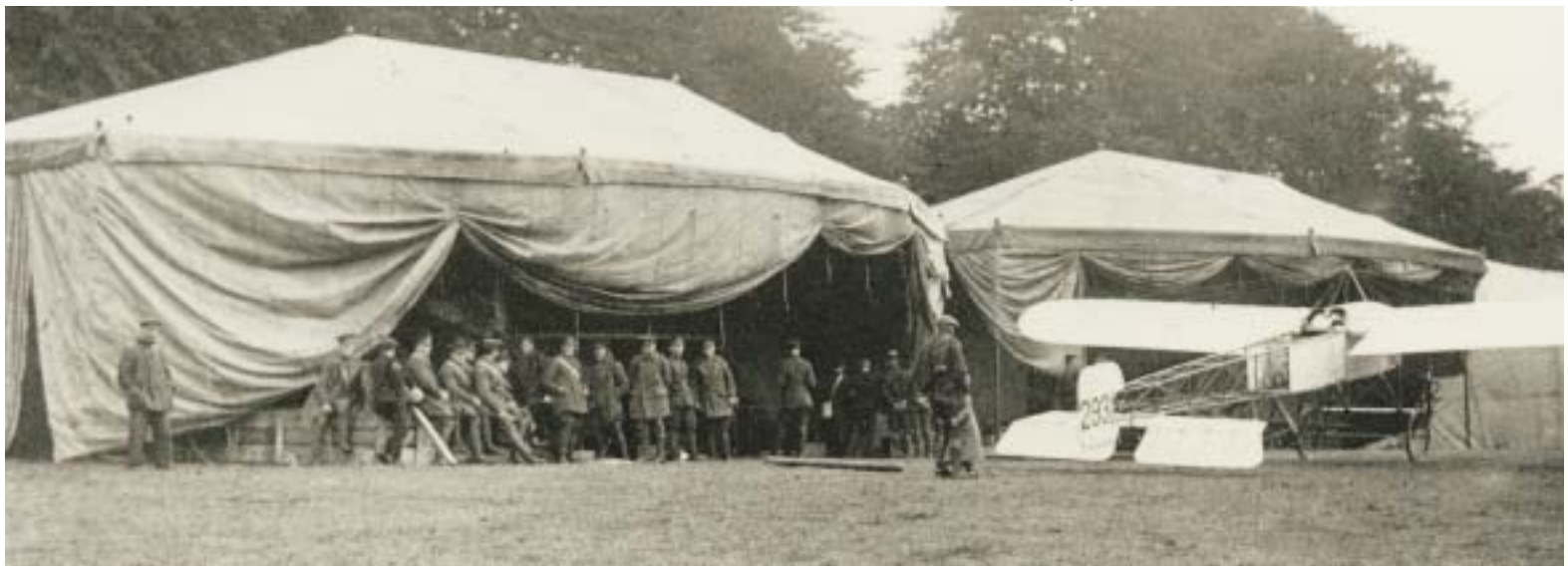
First Landing: 3 Squadron comes to Halton during the 1913 Manoeuvres

By Francis Hanford

The Royal Air Force station at Halton has a long tradition and fine reputation as a training unit. Starting when the estate was lent to Lord Kitchener in 1914 for the preparation of infantry for the new volunteer army, his 'First Hundred Thousand', the emphasis moved to aircraft maintenance in 1916 and, by the end of World War I, there were some 10,000 men, women and boys under training. They were to be followed by Lord Trenchard's apprentices, some 50,000 of them in 155 entries from 1920 to 1993, augmented by vast numbers of other trainees on shorter courses, especially during World War II. Today RAF Halton is the home of recruit and non-technical ground training and celebrates the 90th anniversary of its first encounter with the Royal Flying Corps, which became the RAF. How appropriate it is that this first landing should be during a training exercise — the army manoeuvres of 1913.

The reverses suffered by the British army at the hands of the Boers during the South Africa War had initiated many fundamental reforms, particularly in methods of and attitudes to training. Large-scale manoeuvres became an annual event, developing and testing the co-ordination of the various larger formations and their supporting

The Bleriot of Lieutenant Joubert de la Ferte at Halton



services. Further impetus was given to the need for these exercises by an increasing awareness of the growing power and militancy of Germany. She was developing her international influence and empire, confronting British and French interests in Africa, the Middle East and the Balkans. In 1911 she had even intervened in the internal politics of Morocco in support of the anti-French faction by sending two gunboats into the port of Agadir. She had only backed down when her main dockyards and her access to the Atlantic were threatened by the Royal Navy's Grand Fleet, mobilising for a full scale confrontation in the approaches to the Baltic.

Thus, it was that the manoeuvres in 1913 were of unprecedented size and scope. The planners were particularly anxious to exercise the logistical support services, as the horse drawn wagons of the Army Service Corps were in the process of being replaced with motor lorries and they hoped to gain experience in the operation and control of these. Also, they wished to discover whether a single main road could carry the motorised traffic necessary for the support of two divisions. Thus a fluid scenario was essential and it was decided that the enemy 'Whiteland' forces, consisting of little more than a cavalry screen, would retreat northwards, across Buckinghamshire, in the direction of their capital city, Nuneaton, pursued by the main 'Brownland' army of three divisions. To assemble the necessary forces in the vicinity of Aylesbury, divisional manoeuvres were held between 11 and 19 September. Two divisions marched northwards from Aldershot while the third advanced North-Eastward from the Salisbury plain area.

After its successful debut in the 1912 manoeuvres, when its aircraft had played a crucial role in detecting every move of the opponent's forces for whichever side they were supporting, the Royal Flying Corps was expected to play a full part in the proceedings. The airships of 1 Squadron and the aircraft of 4 and 5 Squadrons were to support the 'Whiteland' army while 3 Squadron was allocated to 'Brownland'. The new corps had very few precedents to follow and preparations were protracted and involved.

Preparation: much to do

As commander of 3 Squadron, Major Robert Brooke-Popham, had much to do. The shortage of aircrew had to be made good to allocate a pilot and observer to each aircraft and appoint a supernumerary adjutant and transport officer. This was accomplished by reclaiming, on loan, personnel

Major Brooke-Popham, Commander of 3 Squadron

who had been given up to facilitate the formation of 5 Squadron and the diversion to ground duties of Lieutenants Allen and Christie. Aircraft were to be prepared and the undersides of the wings marked to facilitate recognition from the ground. This was long before the roundel was introduced and the under-wing area had to be divided into five equal areas, the outer and centre of which were to be painted black. Transport had to be brought up to the approved scale of tenders, lorries, mobile workshops and motorcycles. Tentage was to be assembled, for men and aircraft servicing, and special weather-proof canvas covers for cockpits, engines and propellers were to be made by the tailor because tents for overnight storage of aircraft were not deemed necessary by the authorities.

On top of this necessary administration, he received a confidential briefing on the plans and was authorised to reconnoitre the area of operations to identify suitable landing grounds. These were required to be at least 200 yards square without stones or ridges and furrows and with hedges no more than five feet high. If higher obstacles were found the length was to be extended by a distance equivalent to 12 times the extra height. For this last task 'Brookham' (as he was known to his troops) was exceptionally well qualified. Having served in the Oxfordshire and Buckinghamshire Light Infantry for many years he knew most of the landowners in the area well and could command hospitality wherever he went. Travelling in the taxi, hired by the army for the purpose, he would drop in and accept the meal that was invariably offered. His adjutant, who accompanied him, found this proceeding extremely difficult. His leader rarely told him of his plans and almost invariably fell asleep after coffee, leaving Allen to carry on a polite conversation with his hosts. As the evening progressed he would be asked whether they would be staying for the night and would have to confess that he was not privy to their plans. If, when the great man awoke, he decided to return to base, his unfortunate subordinate would be required to locate their tired, and not always sober, driver and endure a long night drive back to their base at Netheravon, on Salisbury Plain.

The availability of aircraft was also a problem. At this early stage in the history of flying the serious production of airframes in any quantity was confined to a few French pioneer constructors. The Royal Aircraft Factory at Farnborough was experimenting with its early designs and other British makers were also only at the development stage, or were building French models under license in small numbers. Thus the Royal Flying Corps was forced to use what it could get, fielding a great variety of types and experiencing considerable problems in maintaining serviceability. Eventually, 3 Squadron managed to field 11 of the 12 machines expected. They were a typical mix for the time: 4 Henry Farman F 20s, 4 Bleriots and 3 different Bleriot Experimental types from the Royal Aircraft Factory: a BE 2a, a BE 3 and a BE 4.

The Henry Farman was a two-seat pusher biplane built in France by one of a pair of English brothers, Henry and Maurice. Their aircraft followed the principles of the Wright brothers' designs but with a nacelle to protect the crew, aileron control in place of wing-warping and the removal of the forward elevator on most models. Slow, stable and easy to fly, their products were to be used in considerable numbers for initial training before and throughout WW I.

The Bleriots were tractor monoplanes very similar to the machine in which Louis Bleriot had crossed the channel in 1909. However, the 23 hp Anzani engine in his original machine had been replaced with a 50 hp Gnome rotary in the two, single seaters and 70 and 80 hp Gnomes in the two-seaters. Also the tail plane and elevator had been redesigned and the tail wheel replaced with a skid. This last change was to aid stopping in an era prior to the introduction of undercarriage brakes. Although this make was extremely popular for air races and widely used by European air forces for reconnaissance and bombing it was to be relegated rapidly to the training role and then to obscurity once serious hostilities started.

Rather more advanced in design were the three Royal Aircraft Factory BEs. Indeed the Aeroplane had acclaimed the BE 4 the previous year with a drawing labelled: '*How to build an aeroplane — It will be noted that the upper plane is staggered forward and that the body is streamlined to the utmost possible degree*'. These two-seater tractor biplanes with aileron control were inherently stable in flight and were early examples of a configuration which was to change little till the mid-1930s. The aircraft developed from these early examples were to carry out the bulk of the British reconnaissance and artillery spotting tasks for the duration of the coming hostilities.

The Squadron deployed on 12 September. 'A' and 'B' Flights flew to Haineshill to support 1 and 2 Divisions, encamped at Billingbear Park, and 'C' Flight joined 3 Division at Hungerford. Details of this first phase of the manoeuvres are sketchy in the extreme as the squadron flying records do not cover the period and only the sorties done in support of the later, army level, operations are detailed in the squadron commanders final report. In this he ends his general comments with a slightly petulant section in which he stresses the need for the air effort to be taken seriously. This reflects on the very real risks taken daily by the aviators of the time, and suggests that, during the earlier period, neither these nor the information they collected were always appreciated.

From the very terse journal maintained by the commander of 'A' Flight, Captain Allen, we learn the outline of his and 'B' Flight's movements. He wrote:

12 Sep: *Sent off the flight on ahead to Haines Hill.*

13 Sep: *Up at daybreak, decided too foggy to fly, strong wind all day, started at 1615, found it quite pleasant and landed at Haines Hill at 1715. In camp: Picton-Warlow, Birch, Abercromby: House (umpire), Porter, Stopford and self.*

14 Sep: *Pretty busy all day, conference with staff, looked for landing ground. Visit from Sykes (Colonel F H Sykes, the commandant of the Military Wing of the RFC).*

15 Sep: *Porter (BE 3) and Stopford (Henry Farman) out reconnaissance, dropping message bags, same in pm.*

16 Sep: *Dense fog in am and operations ceased at 1300.*

17 Sep: *Had to attend a conference. Went to see staff in pm.*

18 Sep: *Thick fog till 1100. Shifted to Rose Hill. Staff left us severely alone all day. No flying.*

19 Sep: *Not a word from the Staff and very foggy. Flew 203(BE 3) in the pm.*

From this we can infer that though his duties as deputy squadron commander involved him with the staff and in other duties, the reconnaissance tasking was not particularly onerous, which bears out his superiors comments on not being taken seriously. Concerning the 4 Bleriots of 'C' Flight, under the command of Captain Fox, we know much less. The 3rd Division had advanced via Hungerford, Wantage and Oxford but no mention is made of the locations of the landing grounds. The only specific facts we have from him are that aircraft serviceability was poor and that they: '*could only keep two aircraft flying at any one time*' and that: '*Wadham and Joubert each changed engines twice*'.

“Brookham” discusses a sortie with Captain Allen in front of the BE 3

The first phase ended on 19 September and the time had come for the separate Divisions to coalesce into whole armies. The troops were to be given three days rest, encamped on private estates across mid-Buckinghamshire, while the staffs reorganised. The arrival of the two armies, made up of some 50,000 troops, with 14,000 horses, artillery and hundreds of supply wagons, made an enormous impression on the local populace. It is hardly surprising that their lines of march and camp sites were the objects of enormous curiosity and all who could got out to enjoy the spectacle.

Welcoming the troops

On the Halton estate Mr Alfred de Rothschild welcomed the troops with open arms. These included a brigade of Guards, battalions of the Black Watch and Munster Fusiliers and a battery of field artillery. Not content to merely allow them onto his land, he had hired marquees and caterers to ensure their every comfort. The military authorities had rejected his offer to provide all meals for the troops but this failed to deter him from supplementing their rations on a most generous scale.

On three successive evenings 3,000 soldiers were given a high tea of hot pies, cold meats, bread and butter, washed down with tea, beer and mineral waters. Indeed, the beer was served by the quart and Lieutenant Allen noted that, hot from the long march, the troops did it ample justice. It is no wonder that their host was received with hearty cheering when he visited the mess tent!

The officers were entertained on an even more lavish scale. Their mess marquee was decorated with floral arrangements, the best chefs were employed and champagne flowed freely. When Lieutenant Allen had arrived ahead of the squadron to set up the tents in advance for the aircraft and personnel, he was invited to stay in Halton House. He had felt compelled to refuse the offer but his host had insisted that he take all his meals there and had even provided him with a horse to make transit to and from the landing ground easier.

For the use of the Royal Flying Corps Mr Rothschild had provided a field from which the sheep had been cleared — the other side of the Tring Road from the main encampment. This is the site on which the Maitland Parade Square and its attendant barrack blocks were to be built during the 1920s. It conformed to the official RFC size requirements but, being close under the ridge of the Chilterns and sloping downwards to the West, access from the air was not easy. Pilots coming in to land were faced with the options of landing uphill, with the prevailing wind, or of approaching from the South along the side of the hills and turning into wind to land down hill with only a tail-skid as a brake. Fortunately, their aircraft was capable of landing in very short spaces but the fact that the permanent airfield of what was to become RAF Halton was established a mile away to the West is hardly surprising.

Captain Allen, Commander of 'A' Flight

On this sloping pasture the ground crew, under the direction of the adjutant and the transport officer, erected the tents, identified the centre of the landing ground with a large white cross of American Cloth and marked its perimeter with yellow flags. They then settled down to await the arrival of the aircraft while enjoying three meals a day provided by their host. Their feeding arrangements were independent of the main body and ignored the fact that they were receiving a cash allowance of one shilling a day in lieu of rations. This had been authorised by the army command because they often had to leave camp for extended periods to rescue aircraft in distress.

According to the account in the local newspapers, the first aircraft they saw did not touch down. It appeared on the Wednesday and made a detailed reconnaissance of the landing ground before disappearing over Combe Hill. It was followed on the afternoon of Thursday 18 September 1913 by the four aircraft of 'B' Flight, under the command of Captain Herbert, alighting in the designated area. Unfortunately the identity of the first to land has eluded the reporters of the event. The rest of the squadron flew in during the following two days, the first to land being recorded as the Bleriot of Lieutenant Joubert, at 1.30 pm on the Friday.

Half an hour later the excitement of the occasion was heightened dramatically, if unintentionally, by Lieutenant Wadham. Misjudging his final approach, his Bleriot overshot the landing area, narrowly missed some spectators and ended up in the hedge beside the Wendover-Tring road. Fortunately he and his mechanic, AM 1 Bowyer, were uninjured and the only damage to the aircraft was a broken propeller.

Luckily, the honour of the squadron was recovered at 6.30 pm when Lieutenant Laurence, with Major Brooke-Popham as his observer, executed a perfect landing after 'a brilliant spiral volplane (gliding with the engine cut)' from 8,000 feet, coming to a halt neatly parked 30 yards from the aircraft tents. The last to arrive was Captain Allen who had had to attend yet another Staff conference before flying in on Saturday afternoon.

Captain Herbert, Commander of 'B' Flight

Captain Fox, Commander of 'C' Flight

We must remember, at this point, that these events took place a mere five years after the first flight in Britain and that the vast majority of the population would never have seen an aeroplane. The chance to feast their eyes on this new technology at first hand provoked great excitement. Rope barriers — guarded by two policeman and the estates' 12 game-keepers — had to be erected to control the crowds of onlookers, who were present in greatest force on Sunday when they were very disappointed that the poor weather prevented flying. Sympathetic to their curiosity, Major Brooke-Popham arranged to have aircraft parked where they could be seen and allowed generous access to the local press who reported on every aspect of the manoeuvres in great detail. Meanwhile, his officers were entertained to a special performance of Mr Rothschild's private miniature circus, with their host acting as ringmaster.

On Monday 22 September hostilities were resumed, but the day dawned foggy and reconnaissance sorties could only be launched after 11 am. In spite of this, the early morning was enlivened considerably by the emergence from the mist of the airship Delta which was observing for the 'Whiteland' forces. A Henry Farman, which happened to be airborne at the time, headed straight for the enemy and a Bleriot and a BE took off quickly to intercept. In the space of six minutes these latter were able to fly around and climb above the interloper, allowing 3 Squadron to claim that they could have destroyed it, had they been armed for the purpose.

This event was seen as having great military significance and provoked considerable discussion after the manoeuvres. The fact that an airship had reconnoitred successfully, in conditions which had grounded heavier-than-air machines, suggested a potential which was not to be borne out by later events. Nor was the opinion of the general staff, published in *The Times* on 4 October, that Delta would have driven the aeroplanes off, because 'she was a steadier platform' to prove to be sound. However, the final word on this matter must go to Captain Allen, who takes 3 Squadron's side but adds: *'Whether of course a Zepplin could have been so easy to tackle is another matter'.*

3 Squadron aircrew involved in the 1913 manoeuvres

Name	Post	Cert	Date	Remarks
Maj R Brooke-Popham	Sqn Cdr	108	18.7.11	Observer — Tail No 266
Lieut A Christie	Tpt Off	245	16.6.12	Ground party
Lieut D L Allen	Adj-P	318	15.10.12	Ground party
Capt C R W Allen	'A' Flt Cdr-P	159	14.11.11	BE 4 Tail No 204
Capt W Picton-Warlow	'A' Flt-O	451	1.4.13	BE
Lieut R O Abercromby	'A' Flt-O	134	12.9.11	BE
Lieut G T Porter	'A' Flt-P	169	9.1.12	BE 3 Tail No 203
Lieut W Lawrence	'A' Flt-P	113	1.8.11	BE 2a Tail No 226 on loan (5 Sqn)
Capt P L W Herbert	'B' Flt Cdr-P	244	16.7.12	HF
Lieut R Cholmonderley	'B' Flt-P	271	13.8.12	HF
Lieut T O'B Hubbard	'B' Flt-P	222	4.1.12	HF
Lieut G B Stopford	'B' Flt-P	300	17.9.12	HF Tail No 351
Lieut A Shekelton	'B' Flt-O	399	21.1.13	HF
Lieut G Adams	'B' Flt-O	495	29.5.13	HF on loan (5 Sqn)
Lieut W C K Birch	'B' Flt-O	375	17.12.12	HF on loan (5 Sqn)
Capt A G Fox	'C' Flt Cdr-P	176	30.1.12	Bleriot Tail No 219
Lieut V H N Wadham	'C' Flt-P	243	16.7.12	Bleriot Tail No 221
Lieut E L Conran	'C' Flt-P	342	22.10.12	Bleriot Tail No 292
Lieut P B Joubert de la Ferte	'C' Flt-P 2	80	3.9.12	Bleriot Tail No 293
Lieut E R L Corballis	'C' Flt-O	378	17.12.12	Bleriot
Lieut E N Fuller	'C' Flt-O	325	15.10.12	Bleriot

P: Pilot; **O:** Observer: all aircrew were qualified pilots and held Aviators Certificates; **Cert:** Aviator's Certificate granted by Royal Aero Club of the United Kingdom; **Date:** Date Certificate granted; **BE:** Bleriot Experimental: two-seat tractor biplane made by the Royal Aircraft Factory at Farnborough; **HF:** Henry Farman F20: two-seat pusher biplane of French manufacture

This excitement over, two BEs, a Henry Farman and a Bleriot took off to check the enemy's movements and then to drop messages detailing the results of their observations to the 'Brownland' cavalry headquarters near Aylesbury. Shortly after 11 am another airship, the Eta, was sighted and an aircraft was launched to attack her, but contact was lost in the hazy conditions that still prevailed. These reconnaissance sorties proved successful, each aircraft covering 100-120 miles and returning safely.

However, one of the Henry Farmans was forced to land at Staverton, by engine trouble, and was adjudged to have been captured and the BE 4 of Captain Allen suffered from lack of power. The former had to have the oil joints on its pulsator remade and, for the latter, an engine change was deemed necessary. This had to be done in the open air as the tents were being taken down, in preparation for the squadron's next move. This was most unfortunate as there was heavy rain for much of the night.

Now the centre of operations moved Northwards, into the Buckingham area, and Tuesday saw the departure of the bulk of the squadron for Padbury. High winds kept them grounded for the whole morning, the Bucks Advertiser reporting that '*(Sergeant) Major Ramsay told our representative that it was asking for trouble to ascend in such weather*'. This was born out when the one Bleriot which attempted to take off returned to earth rapidly having been, as the paper gleefully reported,

'buffeted about like a cork on the waves'. When the weather moderated in the afternoon they did get away, leaving 'B' Fight behind. On their way they were able to do further valuable reconnaissance tasks.

Remaining behind also was Captain Allen, whose aircraft's engine still refused to perform properly. His mechanics had to spend that day, and much of the next, cleaning and reinstalling the original engine. This probably involved purging its fuel system and cleaning off the carbon which the total loss lubrication system deposited in copious quantities on the valves and spark plugs. Although the high winds persisted his predicament could be allowed to delay 'B' Flight no longer and they left for the operational area during the morning.

Allen finally departed at 3.30 pm and, after 20 minutes flying in very bumpy conditions, rejoined the squadron at Towcester. As the Halton Estate employees tidied up and discussed the recent events none could foresee the return of the troops in a year's time, when they would be in far greater numbers and with an infinitely grimmer task in prospect.

Departure: moving northward

As the war moved northward, 3 Squadron was in the van, acting as the eyes of the army. They recorded some 26 reconnaissance sorties over the next four days, systematically observing the battle area and the enemy's lines of communication to meet the intelligence needs of the general staff. This proved neither easy nor realistic, for while the aircraft of 'Whiteland' could locate and watch substantial numbers of 'Brownland' troops, they had only a screen of cavalry and a few cyclists to identify. Here the lack of experience of their observers became all too apparent.

To assemble the manpower needed to fill their establishment had proved hard enough; to find crews with the expertise needed, at a time when the RFC was expanding, was almost impossible. Still, they made the best of things and learned much in the process. They were to reap the rewards of this experience and their efforts to learn from it 12 months later, as they followed and reported on the movements of the Kaiser's armies in France.

The fact that they were able to meet the flying task was due, in no small measure, to the success of

A Henry Farman and Bleriot at Halton with BE4 in the tent. Note the Black recognition markings under the H-7's wings

their support arrangements. There were some 140 ground staff on the squadron strength. Each aircraft had its own designated rigger and engine mechanic, each flight had a carpenter, a sail-maker, a photographer and a signaller, while drivers, cooks, officers' servants and the crews of the two workshop lorries accounted for most of the rest. These last-mentioned were kept very busy with repairs to aero-engines, metal brackets and cowlings while devoting equal time and energy to keeping the squadron's vehicles and motor cycles serviceable.

That an adjutant and a transport officer should be needed to direct and control this complex team while the aircrew got on with the serious and hazardous business of flying, comes as no surprise. In an anecdote in which he criticises 'Brookham' for pocketing unread a message delivered to him by a despatch rider as he set off on a sortie, Lieutenant Allen underlines the need for the formal separation of operations and administration. On this particular occasion the preparations for a move were delayed but, had the squadron commander been captured, the enemy would have gained valuable intelligence. Finally, it was shown that the skill, determination and morale of the ground crews could be supported efficiently by the Ordnance and Army Service Corps. These organisations provided the 790 gallons of petrol and 100 gallons of castor oil engine lubricant they used, as well as spares and many other necessaries as and when needed.

As well as exercising air and ground crews, the manoeuvres gave the RFC the opportunity to evaluate the aircraft they were using, under the conditions that might be expected in wartime. After his squadron had covered some 4,545 miles on reconnaissance and 3,310 miles on other flights, operating from eight temporary landing grounds, Major Brook-Popham was in a position to report with authority.

The BE 3 and 4 he liked, commenting favourably on their performance in wind and their slow landing speed. To improve their utility he suggested that the observer be given writing facilities, that ingress and egress for the crew be made easier and that access to the engine for servicing be improved.

The Henry Farmans had proved disappointing. If left out in the rain, or in heavy dew, the wings had filled with water which had to be released by puncturing the fabric. The resultant waterlogging of wood and linen had increased the overall weight and caused wing distortion which ruined performance, limiting the aircrafts' ceiling to 3,000 feet and even causing one of them to be restricted to single-seat operation at times. Their redeeming features were that they had proved to be good observation platforms and were able to turn quickly and to land in very small spaces.

The Bleriots he considered to have many advantages. Provided that they were fitted with the most powerful of the engines available, they were 'good wind machines', fast, able to climb well and to land and take off in small spaces. Also they had stood up to the weather well and their undercarriages had coped with a lot of rough use. Their disadvantages were that they were unstable, making them very tiring to fly and causing discomfort and even 'seasickness' to their observers, whose position offered inadequate protection and very limited forward vision. With the view ahead obstructed by the wings and fuselage they could give very little assistance to their pilots with navigation.

In conclusion

The manoeuvres were judged a success. It said so in *The Times* and also in the final report, signed off by no less a personage than the King. The former had stated that 'Our Flying Corps can now be reported competent to supply this information and it has consequently justified its existence and its cost'. Even more important than these opinions was to be that of Sir John French, who had gained considerable confidence in the RFC's ability.
A year later, as commander of the British Expeditionary Force in France, he was to use the results of the RFC's reconnaissance flights, the first of which was done by Lieutenant Joubert, to make the moves that would contain the German advance and save Paris.

The Times also aired the question of whether competing air forces might have to fight for information, a point which, as we have seen, was already exercising the minds of 3 Squadron. Their aggressive response to Delta's intrusion was another first by a unit with many firsts to its name and this one they can, perhaps, share with Halton, whose hospitality they enjoyed so much.

In 90 years both organisations have come a long way and become pre-eminent in their own fields of expertise while supporting a common purpose.

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Book Reviews

AIR POWER IN SMALL WARS:
FIGHTING INSURGENTS AND TERRORISTS

By James S Corum and Wray R Johnson

Published by University Press of Kansas
ISBN 0-7006-1240-8
Price £20.50

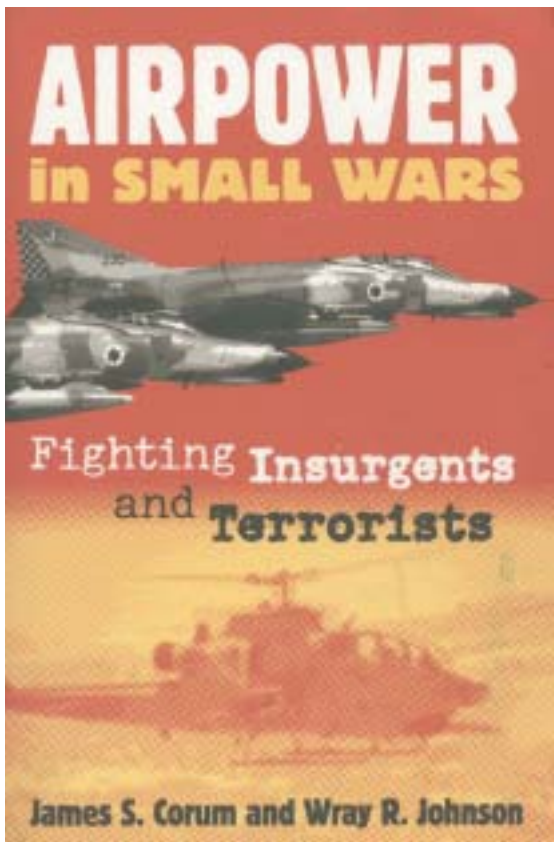
Reviewed by Group Captain Chris Finn

A recent quick survey of the shelves of the Joint Services Command and Staff College's extensive library revealed a plethora of books on air power in support of all aspects of land warfare. There were even more books on the role of land power in counter-insurgency and counter-terrorist operations. However, Corum and Johnson's book, of which there were a respectable number of copies, sat in splendid isolation on the shelves between combat search and rescue and electronic warfare. This unscientific survey would, therefore, seem to support the publisher's contention that Air Power in Small Wars is the first comprehensive history of the use of air power in conflicts pitting states against non-state groups.

Having defined 'small wars' in terms of their nature rather than their length, the authors examine a series of conflicts ranging from the relatively well known to the almost unknown. The former category includes such examples as the use of colonial air control in the inter war years, and the successful British suppression of the Malayan insurgency of 1948-1960. There are then some lesser known conflicts, such as the French colonial wars in Indo-China and Algeria and, indeed, the use of American air power in South Vietnam in the decade leading up to the full American military involvement in that country. The latter category includes campaigns such as the Philippine response to the Hukbalahap insurgency and the US Army actions against the Mexican revolution under Pancho Villa. Finally, the authors look at how air power was used against insurgencies in Southern Africa, Latin America and the Middle East. Chronologically the book is well structured with each individual campaign being dealt with by firstly examining the historical and political context and the relative strengths and weaknesses of the adversaries, then a brief history of the campaign itself, and lastly the specific air power lessons that can be drawn from it. The contextual aspects of each campaign will be particularly interesting to airmen who generally do not tend to read into those areas, and the authors' analyses give both the pros and cons of the use of air power in each conflict.

However, the authors' detachment slips slightly in their consideration of media and public opinion of the Israeli-Hezbollah/PLO conflict. The only other campaign which the authors could profitably have addressed is the anti-terrorist one in Northern Ireland which has lasted for over 30 years, and which does not seem to fit the authors'

Book Reviews



paradigm in that this conflict involved a terrorist organisation that had a clear political end state it wished to achieve.

The book concludes with the discussion of 11 lessons, which follow on from the analyses at the end of each particular chapter. Among them are the points that small wars require pan-governmental, as opposed to just military, solutions and that those military operations have to be entirely joint. They also make the interesting point that both high and low-tech elements of air power have their place in these conflicts. Finally, they clearly identify the vital role played by the supporting capabilities of airpower in 'small wars'.

In summary, this is a well researched and well written book dealing with an aspect of the use of air power which has, until now, not had the exposure it deserves.

Book Reviews

The Last Escape

By John Nichol and Tony Rennell

Published by viking books
ISBN 0670910945
Price £20.00

Reviewed by Seb Cox

The popular image of British Prisoners of War during the Second World War is still largely moulded by the portrayals on television and in Hollywood films.

Amongst the latter *The Great Escape* is by far the best known. It was loosely based on the events surrounding the mass breakout of British Commonwealth Air Force prisoners from Stalag Luft III at Sagan. Although the dreadful consequences of the breakout, whereby 50 of the escapees were murdered by the Gestapo, are related in the film they do not form the major part of the action.

The essence of the film, and that of previous feature films in the genre such as *The Wooden Horse*, is to concentrate on the PoW's attempts at escape.

At the time of writing a new ITV series has just started, again related to life in a PoW camp, and early indications are that yet again much of the action centres around escape-related activity and its dangers; with resourceful prisoners fooling witless or gullible authorities.

The dangers inherent in escaping, so dreadfully apparent in the case of Stalag Luft III, are usually brought out in such programmes, but there is a tendency to portray camp life as in essence being a game played out between prisoners and guards, albeit dangerous in part, but essentially run on well understood lines, which in the case of Sagan were crossed, though not so much by the German military, as by the Gestapo.

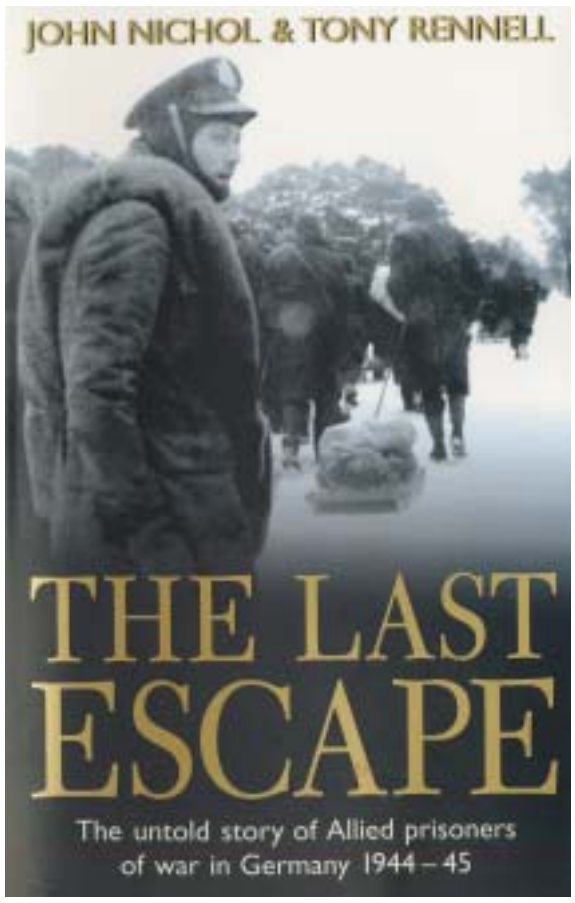
In reality, however, much of a prisoner's focus was not on escape at all, but on survival, with food highest on the list of priorities. Once the Allied armies had landed in Normandy the prisoners were instructed to abandon all attempts at escape in order to prevent further tragedies.

As Nazi Germany began to disintegrate under the pressure of Allied and Soviet armies and relentless strategic bombing, life for the prisoners, never remotely as cheerful as it appears on the screen, became increasingly fraught.

The twin threats to the prisoner were perceived to be German reprisal action, particularly by the SS or Gestapo rather than the Wehrmacht, and starvation and disease.

By early 1945 the Germans were faced with the problem of moving Allied prisoners away from the

Book Reviews



advancing Soviet armies. By the spring they faced the same problem in the West. The result was the evacuation of camps, firstly those in Poland and eastern Germany, and later those in the path of the Western Allies. The early evacuations were sometimes done by train, but as the Third Reich's transport system fell apart as a result of bombing the Germans resorted to forced marches.

Allied prisoners were herded across Germany in an increasingly disorganised and *ad hoc* fashion, sleeping in barns, barracks, outhouses or the open fields, and moved from camp to camp. Stalag Luft III was evacuated in the middle of the night as the Soviet armies rapid rate of advance took the Germans by surprise.

In *The Last Escape* John Nichol, himself famously a guest of Saddam Hussein's 'goons' in the first Gulf War, and his co-author Tony Rennell set out to tell the story of these events. They cover in great detail the story both of those who went on these

Book Reviews

marches, and those who were left in the camps, the latter frequently because they were already physically incapable of moving.

They describe the harrowing conditions the men experienced in the camps and on the march. The constant hunger and the often desperate search for food, and the agonising plight of the sick and exhausted, made worse by the occasional brutality of some (though not all) of their captors. The added danger of misdirected air attack added to their worries.

Some columns of prisoners seem to have been known to Allied pilots, who buzzed the columns, without attacking, but the authors also describe the awful fate of some prisoners so tragically killed by mistake in the final days of the war when the marching columns were misidentified and attacked. Some temporary camps were also mistakenly strafed.

Some prisoners spent as much as three months on the road as the Germans desperately sought to keep them ahead of the advancing Soviet columns. They suffered all manner of privations, with frostbite and dysentery as well as semi-starvation amongst their woes.

If the prisoners were wary of 'blue on blue' attacks, they were equally concerned at the reactions of their jailors. Whilst many German guards, particularly those who had been in the camps for a long time, became increasingly anxious to demonstrate to the prisoners their own humanity, the prisoners were gripped by fear of reprisal. In the event that a massacre began the prisoners in Sagan planned to attack the guards with their bare hands to try to seize weapons to fight back.

Although this nightmare scenario never came to pass, in at least one camp armed SS troops actually appeared at the gate in the last chaotic days of the war, intent on a massacre. They were argued out of it by the elderly 'volksturm' guards; an action requiring no little courage on the latter's part. The prisoners had been determined to rush the gates had the massacre started, in the hope that some at least would have escaped.

As the situation became increasingly chaotic many prisoners escaped from columns, and in the final days of the war even took over the camps from their co-operative guards before Allied troops arrived.

In *The Last Escape* the story is well told, using a mixture of personal recollection and official documents. There are also some excellent photographs, including some which illustrate the straits to which many prisoners, especially those in certain camps, notably Fallingbostel, were reduced.

If one were to look at such photos without benefit of the caption one would assume that the prisoners were victims either from a concentration camp, or from the horrors of a Japanese camp. Fallingbostel was particularly badly affected because so many of the displaced PoWs, perhaps 100,000 or so of all nationalities, ended up there. Some prisoners lost a third or more of their bodyweight and many weighed less than a hundred pounds on their release.

The book contains a discussion concerning the number of prisoners who died on the marches. This remains a subject of debate even amongst the PoWs, with one quoted as saying that he did not consider the term 'death march' appropriate and preferred the term 'misery walk'.

Perhaps in the context of the infamous death marches which took place in the Far East this is a realistic assessment. The authors of this study do

Book Reviews

try to come to a considered figure for the number of PoWs who died on the marches. They conclude that it was probably between 2,500 and 3,500, but admit that the evidence is sketchy and that it can only be a best guess.

They state that the Ministry of Defence cannot give them an accurate figure, and that the RAF, whilst it can give figures for killed, wounded, missing and prisoners, has no figure for deaths in captivity. Overall, this may be true, but the figures for Bomber Command, which represented a significant proportion of RAF PoWs, **are** known, and they suggest that those who think the higher estimates inaccurate may well be right.

According to the Official Historians, 9784 men from Bomber Command became PoWs, and of these 138 died in captivity. This represent a death rate from all causes of 1.3 per cent. As a high proportion of the fifty murdered Sagan prisoners (23 out of 50) were Bomber Command this is probably higher than the general average for British Commonwealth PoWs.

Applied to the most reliable figure for the number of British Commonwealth PoWs, this gives a figure of approximately 2200 deaths in captivity. As the author's quote the New Zealand official Historian as attributing a thousand Commonwealth PoW deaths to allied bombing attacks, this potentially brings the figure for Commonwealth deaths on the marches down to a thousand or so. It seems unlikely that American deaths exceeded those of the Commonwealth.

Two undoubted heroes emerge from the story, and neither was commissioned. One was Regimental Sergeant Major John Lord of the Parachute Regiment, captured at Arnhem, and incarcerated at Fallingbostel.

But even Lord's exceptional strength of character is eclipsed by that of an 'ordinary' RAF Sergeant, Jimmie 'Dixie' Deans, who by sheer force of personality and exceptional leadership skills undoubtedly prevented a far worse tragedy both on the marches and eventually at Fallingbostel.

Sadly, as the authors relate, the RAF, with almost purblind stupidity, refused to commission Deans after the war, and the only recognition he received for his exceptional leadership was an MBE.

This is a well researched and thoughtful study which should help to correct the over romanticised view of PoW life portrayed on film and television.

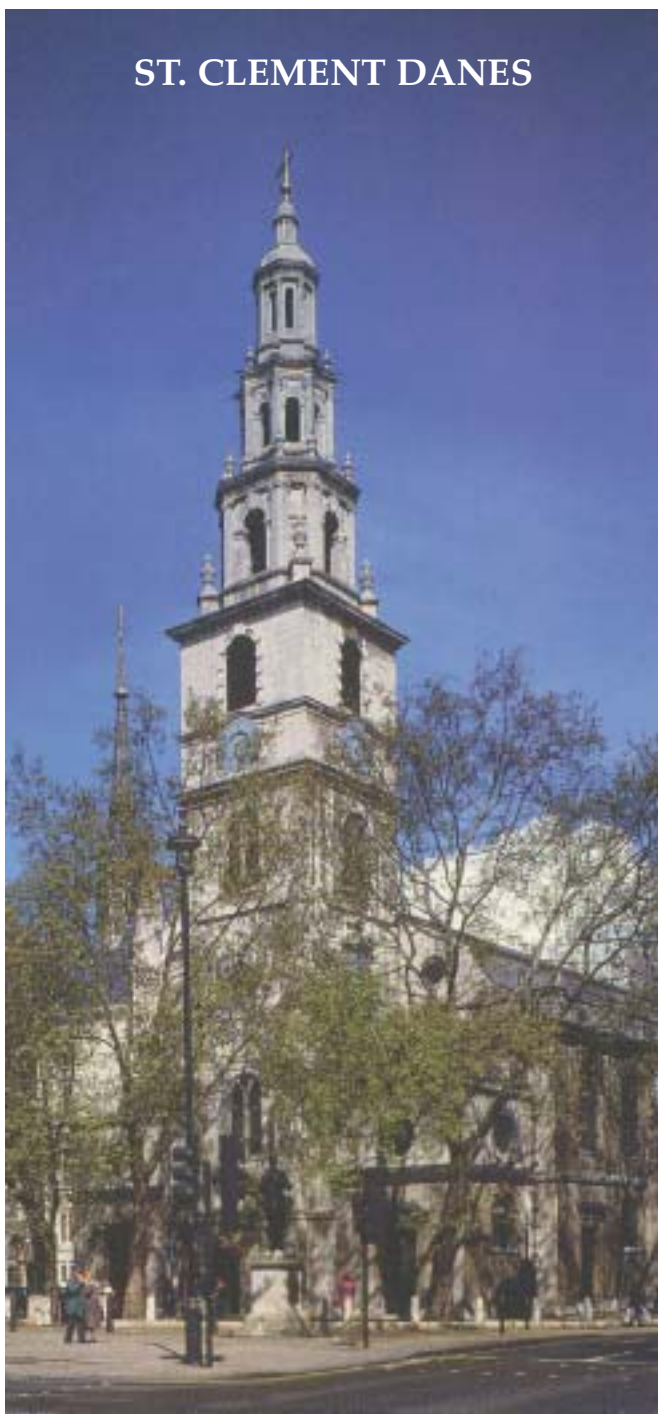
Notes

Notes

Notices/Reunions

ST. CLEMENT DANES, STRAND, LONDON CENTRAL CHURCH OF THE ROYAL AIR FORCE

This beautiful Wren Church, which is also the Royal Air Force Central Church, has a world-wide following and is open daily from 09.00 am – 4.00 pm. There is Choral Eucharist or Matins every Sunday at 11.00 am, sung by the famous choir. Civilians and all members of the Armed Forces are welcome to visit the church and attend the services.



ROYAL AIR FORCE HISTORICAL SOCIETY

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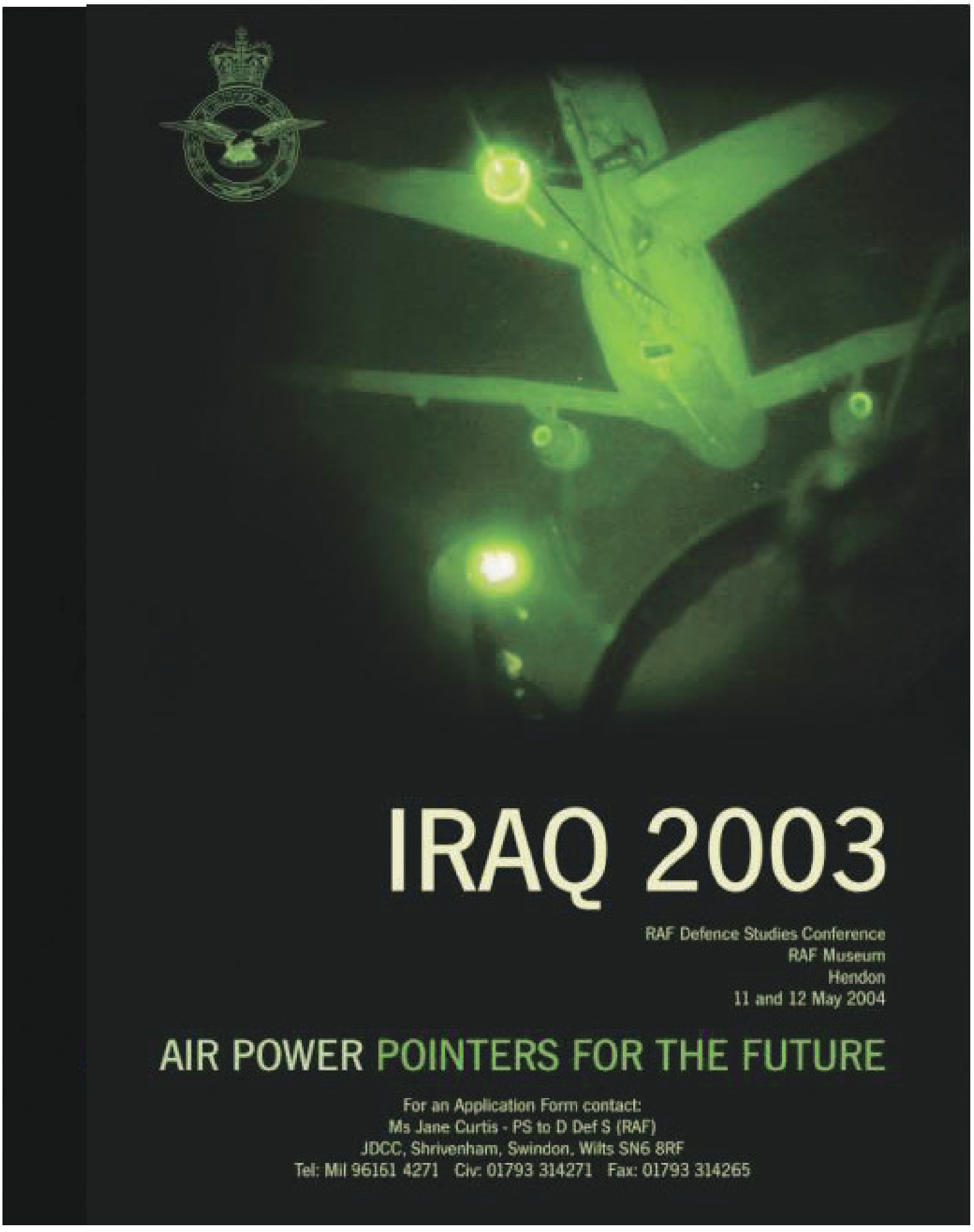
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