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ROYAL AIR FORCE HISTORICAL SOCIETY

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SELECTED GLOSSARY

AAA	Anti-Aircraft Artillery
ACP	Air Campaign Plan
AEDIT	Aircraft Engineering Development and Investigation Team
ALCC	Airlift Control Centre
ASMA	The HQ STC-sponsored Air Space Management Aid was a computerised, 1970s vintage, electronic information storage system which provided secure communications links between VDU terminals. The network was initially confined to a few selected units within Strike Command but it had the potential to be deployed globally and it was rolled out across the whole RAF during, and in the wake of, the Falklands campaign, even embracing some of HM ships. To the operator, it was very much like sending emails, although this was long before the availability of the Internet. It was eventually superseded by more up-to-date systems after more than thirty years of invaluable service.
ATF	Air Transport Force
ATO	Air Tasking Order
AUW	All Up Weight
AWACS	Airborne Warning and Control System
BMG	Battle Management Group
C^2	Command and Control & Intelligence
C^2I	Command, Control
CAP	Combat Air Patrol
CMG	Command Management Group
COBRA	Cabinet Office Briefing Room A
ECM	Electronic Countermeasures
FAP	Fly Away Pack
HAS	Hardened Aircraft Shelter
HQ STC	HQ Strike Command
IADS	Integrated Air Defense System
IFF	Identification Friend or Foe - See SIF
JATE	Joint Air Transport Establishment
JHQ	Joint Headquarters

LGB	Laser Guided Bomb
MACE	Minimum Area Crutchless Ejector
MOB	Main Operating Base
Mode 4	See SIF
MOD PE	MOD Procurement Executive
MPA	Maritime Patrol Aircraft
MTBF	Mean Time Between Failures
NBC	Nuclear, Biological and Chemical
PMO	Principal Medical Officer
QWI	Qualified Weapons Instructor
RAM	Radar Absorbent Material
RHWR	Radar Homing and Warning Receiver
ROE	Rules Of Engagement
RSAF	Royal Saudi Air Force
RWR	Radar Warning Receiver
SAM	Surface-to-Air Missile
SEAD	Suppression of Enemy Air Defence
SIF	The Selective Identification Feature enhances IFF by permitting the identification of individual aircraft, rather than whether it is simply Friend or Foe, although the latter function cannot be carried out with confidence. Hence the addition of Mode 4 (built-in to IFF Mk 12 or as a modification to the Mk 10), which provides secure positive friendly identification, so long as it is working – a lack of response could be an enemy aircraft or a friendly one with an unserviceability.
SOAF	Sultan of Oman's Air Force
STC	Strike Command
STF	Special Trial Fit
TIALD	Thermal Imaging Airborne Laser Designator
TSW	Tactical Supply Wing
UKADR	United Kingdom Air Defence Region
WEU	Western European Union

OPERATION GRANBY – THE RAF IN GULF WAR 1, 1990-91

RAF MUSEUM, HENDON, 13 March 2013

WELCOME ADDRESS BY THE SOCIETY'S CHAIRMAN

Air Vice-Marshal Nigel Baldwin CB CBE

Good morning ladies and gentlemen and welcome to the Royal Air Force Museum. As always, the first thing I must do is to thank the Director General of the Museum, Air Vice-Marshal Peter Dye and his colleagues, for yet again allowing us to use these excellent facilities. I have said this twice a year for donkeys' years but our thanks are most sincere. We would be lost without you.

On the 2nd of August 1990, at 0200 hrs local time, Saddam Hussein's troops crossed into Kuwait. Quoting from the eventual Despatch in the *London Gazette*, 'Iraq possessed the Arab World's most powerful military machine and, with a strength of over a million, the fourth largest permanent army in the World; facing them were the Kuwaiti defence forces, […] a total of 20,300 […] Up to 100,000 Iraqi troops were massed on the border; the Republican Guard Force Command was chosen to lead the invasion. About 30,000 Iraqi troops, including armoured brigades equipped with modern T72 tanks, were used in the main attack across the desert towards Kuwait City, a distance of some 80 miles.'[1]

At the time, I was Air Cdre Plans at HQ Strike Command at High Wycombe. Our Commander-in-Chief was Sir Patrick Hine, who will be our Chairman today. Six days after the invasion, he was appointed by the Chief of the Defence Staff, Marshal of the Royal Air Force Sir David Craig, (a member of our Society), Joint Commander of what became known as Operation GRANBY (the Marquis of Granby was an 18C British general).

Sir Patrick will explain shortly the higher British command structure which, at High Wycombe, used essentially his HQ Strike Command Air Officers – his Chief of Staff, Air Marshal Sir John Kemball, his SASO, AVM Richard Johns, his Air Officer Engineering and Logistics, AVM Michael Alcock, his Air Officer Administration,

[1] *The London Gazette*, Friday, 28th June 1991; Despatch by Air Chief Marshal Sir Patrick Hine GCB ADC FRAeS CBIM RAF – Joint Commander of Operation Granby August 1990-April 1991

AVM Gordon Ferguson, and me, a lowly air commodore. In addition, he soon had a Royal Navy rear admiral, an Army lieutenant general – as Naval and Land Deputies respectively – and a political adviser from the Foreign and Commonwealth Office. Known as the Command Group, it was underpinned by the Battle Management Group under the leadership of the Director of Operations, the then Air Vice-Marshal Johns. Usually both Groups met twice a day throughout the eight months or so of the campaign.

At High Wycombe, we had only recently moved into the new underground command and operations centre – the Primary War HQ – which had replaced that used by Sir Arthur Harris in WW II, and it was that splendid facility that several hundreds of us used for the next eight months.

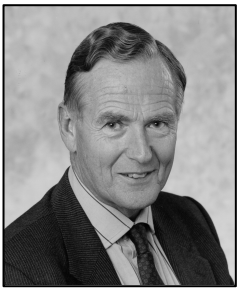
Sir Patrick Hine was very experienced and well placed to take operational command of all our tri-Service forces in the Gulf. He had been Commander-in-Chief at Strike Command for two years, had come to us from being the Vice-Chief of the Defence Staff in Whitehall, and before that had been Commander-in-Chief of RAF Germany where most of the RAF's Tornado force was based.

So it is him that I thank for agreeing to chair today's meeting – nobody is better qualified – and I hand over now with no doubt that he will be able to keep control.

Sir Paddy – over to you.

JOINT COMMANDER'S OVERVIEW

Air Chf Mshl Sir Patrick Hine



Sir Paddy joined the RAF as a National Serviceman in 1951. He flew Hunters with Nos 1, 93, 111 and, as CO, 92 Sqns before switching to the Phantom and commanding No17 Sqn and RAF Wildenrath. His senior appointments included DPR, SASO RAF Germany, ACAS (Pol), CinC RAF Germany/COMTWOATAF, VCDS, AMSO and AOCinC STC/CINUKAIR. On leaving the Service he spent 1992-99 as Military Advisor to British Aerospace.

I was delighted when Nigel Baldwin asked me to chair this seminar, especially as I was unable to attend a not dissimilar one held by the Society a decade ago. My short presentation today will provide a backdrop overview of Operation GRANBY from my perspective as the Joint Commander, thereby setting the scene for the following more detailed inputs concerning the RAF's operations during Gulf War I.

When, the then Prime Minister, Margaret Thatcher decided that the UK would support the Americans in responding militarily to Saddam Hussein's invasion of Kuwait, it was imperative to do so quickly, thereby helping to deter any early Iraqi follow-up incursion into north-east Saudi Arabia, which at the time seemed likely as satellite intelligence indicated that Saddam had massed around 100,000 troops on the Kuwaiti/Saudi Arabian border. Hence the immediate deployment of a squadron of Tornado F3s – fortuitously on detachment in Cyprus at the time – to Dhahran, and a squadron of Jaguars with two VC10 tankers in support to Thumrait in Oman. Three maritime patrol Nimrods were also deployed to Oman (at Seeb) to support the Royal Navy's Armilla Patrol which by 1990 had been operating continuously in the Gulf for some ten years. Shortly thereafter, it was agreed to deploy a squadron of Tornado GR1s to Muharraq in Bahrain. It is perhaps worth adding that Margaret Thatcher was most reluctant to commit any army combat units at that stage; as she bluntly put it, she did not wish to 'get our arm caught in the mangle'!

It is pertinent to outline the higher military command and control

(C^2) structure below Ministry of Defence (MOD) level for Operation GRANBY. Since the late 1970s, the British had appointed a national 4-star Joint Commander (JC) with his HQ in the UK – in this case High Wycombe – for all major out-of-area (non-NATO) operations. Reporting directly to the JC was a 2- or 3-star Joint Force Commander (JFC) who was deployed forward into the operational theatre. This structure worked well during the Falklands War of 1982 but had to be adapted for the Coalition formed in 1990 to deal with Saddam. While it was clear from the outset that the Americans would lead any military operations in the Gulf, Saudi sensitivities had to be observed, and so the British Ambassador in Riyadh, Alan (now Sir Alan) Munro, and I negotiated a position whereby all British forces in Saudi Arabia would be placed for war under the tactical control (TACON) of CINC CENTCOM (General Norman Schwarzkopf), but remain under national command and control and be 'subject to the overall strategic guidance of the Keeper of the two Holy Mosques' – King Fahd. This elegant caveat overcame what was a real issue for the Saudis who had never hitherto had foreign forces stationed on their soil. Remember too that the focus at that particular time was more on defence of the Saudi Kingdom than on relieving Kuwait.

From 1 October 1990, Lt Gen Sir Peter de la Billière was my JFC in theatre, the decision to replace AVM Sandy Wilson in that capacity having been taken following the War Cabinet's agreement to deploy 7 Armoured Brigade. So I, as the JC, had operational command of all allocated forces (full command in the case of Strike Command forces) and the JFC (Commander British Forces Middle East – CBFME – as he was designated) exercised operational control. Under him were the British component force commanders.

In the lengthy run-up to war, I used to visit the Gulf every three weeks or so and on each occasion met separately with Schwarzkopf and the Saudi CinC, Prince Khalid. At my first meeting with the CINC (pronounced as in 'sink') as Schwarzkopf was known, he stressed the vital importance of air power in any operation to expel Saddam from Kuwait. To minimise the risk of heavy American casualties, he would require the Coalition's air forces to reduce the combat effectiveness of the Iraqi army in the Kuwaiti Theatre of Operations (KTO) by at least 50%, principally in terms of their armour and artillery. While that for him was a precondition for any major ground offensive, Schwarzkopf

was at the time clearly supportive of an initial air campaign plan (ACP) put together rapidly in the Pentagon by United States Air Force (USAF) Colonel John Warden, head of a small strategy and planning unit known as the 'Checkmate Division'. At that time, the ACP was stand-alone and not associated with any ground campaign.

The plan was based on the premise that, given the accuracy and lethality of precision-guided weapons and the optimum selection of strategic targets, the Iraqi national leadership could be effectively 'incapacitated', with such paralysing results that there would be no need for any major ground operation to secure Saddam's withdrawal from Kuwait. The initial plan covered three phases:

Phase 1: Strategic air operations against Iraq.

Phase 2: Suppression of enemy air defences (SEAD) in the KTO.

Phase 3: Destroying the battlefield.

By the time I was briefed on the plan at the end of August, the third phase had become 'Preparation of the Battlefield' and a fourth phase, 'Air Support of Ground Operations', had been added. These changes reflected Schwarzkopf's belief, which I shared, that some kind of ground offensive would almost certainly be needed to evict Saddam from Kuwait.

At my initial meeting with Schwarzkopf, he gave his main priorities for a further British military contribution as an armoured brigade with Challenger Mk 2 tanks and more Tornado GR1s equipped with the JP233 airfield denial weapon – a capability that the Americans lacked. It was then that I gave Schwarzkopf an undertaking to recommend to Her Majesty's Government that for war he should be given TACON of our forces in theatre provided the tasks envisaged for them were consistent with my directive from the Chief of the Defence Staff (CDS), and subject to CBFME being a member of the CINC's Command Group and British officers being included in CENTCOM's operational planning teams. He readily agreed to these conditions and eventually there were almost 100 British military personnel involved with the Americans on either planning or liaison duties.

So, to keep things simple: I was Schwarzkopf's British counterpart, my JFC became a permanent member of the CINC's Command

Group, and the British component commanders for naval, land and air forces plugged in to their respective US equivalents for operational planning purposes and for operations themselves, all of this flowing naturally from the bilateral TACON agreement. These overall command and control arrangements for Operation GRANBY may seem somewhat complicated but in practice they worked well, largely because of good working relationships between the American and British commanders at all levels.

Shortly after my initial meeting with Schwarzkopf, the British government agreed to deploy eighteen more Tornados to Saudi Arabia: another squadron of GR1s, which were to be based at Tabuk in the north west, and a further six F3s to join the twelve already operating on daily air defence combat air patrols out of Dhahran. After some toothsucking over the reliability of the Challenger 2 tank, they also agreed to the deployment of 7 Armoured Brigade.

Over the coming weeks, there was a progressive build-up of RAF Regiment Rapier and Light-Armoured squadrons to protect our operating bases, and the RAF Jaguar squadron in Oman was moved up to Bahrain, thereby making it less dependent on in-flight refuelling. In parallel, of course, there was the build-up of 7 Armoured Brigade through the excellent Saudi port of Al Jubail, a major logistic exercise involving mainly sea transit but also very heavy use of the RAF's air transport force which was flying at between two and three times its normal peacetime rate. RAF Puma and later Chinook support helicopters, together with a Royal Navy Sea King squadron, were also deployed to provide battlefield lift for our ground forces.

At a later meeting with General Schwarzkopf at the end of October 1990, which coincided with the transition from Operation DESERT SHIELD (the defence of Saudi Arabia) to Operation DESERT STORM (the recapture of Kuwait), he told me of an ongoing dialogue in Washington over the further build-up of American forces in theatre above the planned ceiling of 230,000. He said that the 'air heads' in the Pentagon were telling the President that the air campaign should be so effective that only mop-up operations by ground forces would be needed. Schwarzkopf and the Chairman of the Joint Chiefs of Staff, General Colin Powell (also a soldier), were very nervous about this advice because the Coalition was currently outnumbered on the ground by about 3:1 – the exact reverse situation from Clausewitz's

recommended ratio for offensive action – and thus potentially vulnerable to flank attacks during the planned main armoured thrust through south-east Iraq (the so-called wide left hook) which was aimed at encircling the Republican Guards divisions and cutting off their main lines of communication. He was particularly concerned about being dragged into a battle of attrition with mounting casualties and the impact that would have (as in the Vietnam War) on American public support for the war. He asked for my opinion (as an airman!), and I agreed with him that it was far safer, notwithstanding the anticipated impact of coalition air power, to increase the ground forces much closer to parity. I reasoned that the Coalition would almost certainly only get one go at Saddam – that winter, during the cool months and ideally before the religious festival of Ramadan – and we had to be strong enough on the ground to guarantee a quick and decisive end to the war. In the event, he and Powell won the argument, and a further US Army corps, plus three additional tactical air wings, three extra aircraft carriers and another US Marine Expeditionary Force, were deployed to the Gulf. I mention all this because it illustrates the inter-Service politics that were at play in Washington in the run-up to Gulf War I and at a time when there was a major review of defence expenditure in progress post the Cold War. The same was true to an extent in Whitehall, with the 'Options for Change' defence review having been virtually completed when Saddam's invasion of Kuwait occurred and the review was put on temporary hold.

At the same meeting, Schwarzkopf asked for additional British armoured forces and yet more Tornado GR1s. Our War Cabinet agreed and as a result 4 Armoured Brigade was deployed to bring the UK's ground forces there up to light divisional strength. With the further Tornados deployed, the RAF's GR1 and 1A force at Muharraq, Tabuk and Dhahran was brought up to 45 aircraft.

As the last of the large-scale American ground reinforcements could not be in theatre and deployed forward until around mid-February 1991, there was time enough to prosecute the ACP between the United Nations (UN) deadline of 15 January for an Iraqi withdrawal from Kuwait and the commencement of the Coalition land offensive. President Bush was keen to begin operations almost immediately after expiry of the deadline; one fear being that Saddam might suddenly announce his intention to withdraw from Kuwait,

either partially or completely, but then prevaricate with all the complications that that might bring in the UN Security Council. And so the air campaign began on the night of 16/17 January.

The main objectives of the Air Campaign Plan were to:

a. establish air superiority;
b. isolate and incapacitate the Iraqi leadership;
c. destroy Iraqi nuclear, biological and chemical warfare capability;
d. eliminate Iraqi offensive military capability and
e. eject Iraqi Army from Kuwait.

The initial ACP had been developed over the months by the CENTAF Commander, General 'Chuck' Horner, as additional resources became available and the overall war plan took firm shape. However, there remained a strong focus on strategic air operations aimed principally at precipitating the collapse of the Iraqi leadership. While in the event the plan fell short in that respect, it succeeded spectacularly in obtaining rapid air superiority and then air supremacy – a vital prerequisite for the success of our wider coalition air operations and deployment of the ground forces to their forward positions.

We will hear later from Air Chief Marshal Wratten about the RAF's involvement in the air operations and about some of the issues that had to be confronted in the process. One of the frustrations that Commanders faced was obtaining timely battle damage assessments through satellite imagery, one notable example occurring during 'preparation of the battlefield' operations when the intelligence staffs found it very hard to determine whether or not the air forces had been successful in reducing the combat strength of the key Iraqi divisions, notably the Republican Guards, down to Schwarzkopf's stipulated 50%. But, despite this difficulty, by 22 February Schwarzkopf judged, from all available intelligence sources, that the aim had been achieved, certainly in terms of overall combat effectiveness, and he launched his ground campaign two days later. With considerable direct support from the air, it was all over in four days.

I hope that this brief overview has provided the audience with a strategic backcloth for the rest of the seminar when speakers will be covering in more detail specific aspects of the RAF's air operations and their support during Operation GRANBY. This operation saw the

The sharp end of Operation GRANBY, front to rear, Jaguar GR1A, Tornado GR1, Buccaneer S.2B and Tornado F3.

UK's heaviest involvement in conflict since the Second World War; by its end we had some 45,000 British servicemen and women in theatre – the third largest contribution behind the US and Saudi Arabia – and undoubtedly the second best in terms of fighting efficiency. Although the war was won principally through the effective application of air power, all three of our Services, including our Special Forces, played their parts well. It was a very good team effort.

COMMAND AND CONTROL IN THE UK

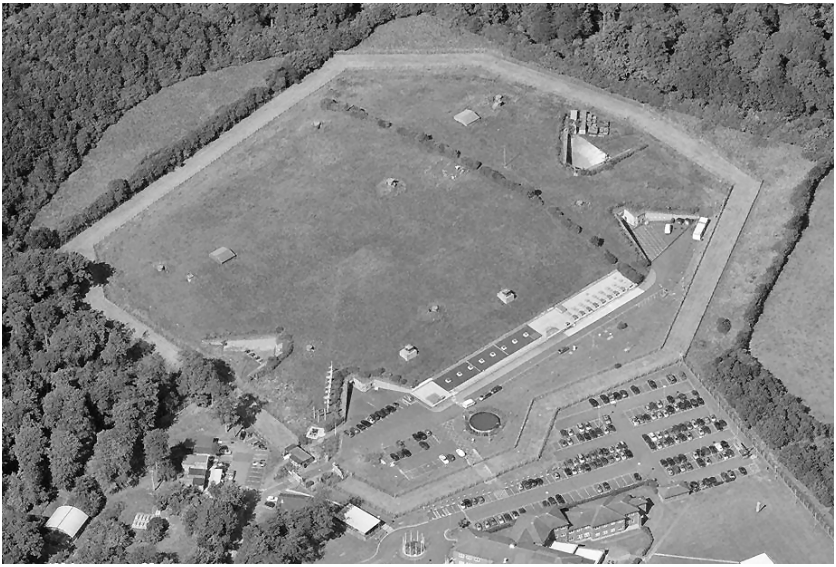
Air Chf Mshl Sir Richard Johns

Sir Richard joined the RAF via Cranwell and spent nine years flying Hunters before becoming a QFI (and teaching The Prince of Wales to fly). He was subsequently OC 3 Sqn (Harriers) and Station Commander at Gutersloh. More senior appointments included SASO RAF Germany, SASO STC, AOC 1 Gp, AOCinC STC (and CINCNORTHWEST) before becoming CAS in 1997. After leaving the Service he spent 2000-08 as Constable and Governor of Windsor Castle

At seminars such as this the subject of Command and Control is normally allocated the first slot after lunch – this to allow the audience dozing time without fear of missing any excitement. So I really am most grateful to Nigel Baldwin for giving me an upgrade to mid-morning to talk about Command and Control in the UK during Op GRANBY.

The structure for the exercise of C^2 was simple. Op GRANBY was directed by HMG, acting through the Ministry of Defence in Whitehall, while the operational centre in the UK was established in the Primary War HQ at RAF High Wycombe which had recently achieved full operating capability. And here I need to stress that although the subject of this seminar is the RAF in Gulf War I, the High Wycombe bunker was a fully joint HQ from 1 October 1990 when RN ships, maintaining the Armilla Patrol, were placed under the operational command of Sir Patrick. On the same day Lt Gen Sir Peter de la Billière was appointed Commander in Theatre with operational control of British Forces Middle East. How this was exercised will be covered by Air Mshl Macfadyen.

Within the bunker the staff were organised into three tiers. At the bottom of the pyramid were the functional cells, some thirty-two of them, who reported to ten 1-star Assistant Chiefs of Staff looking after Personnel, Intelligence, Operations (sea, land and air), Logistics, Plans, Communications and Finance. There was also a separate Special Forces cell. The 1-stars comprised the Battle Management



The recently commissioned bunker at RAF High Wycombe.

Group (BMG) which was chaired by me as the Director of Operations.

The BMG met twice daily before I and selected members of the BMG briefed the Command Group comprising the Joint Commander, his Chief of Staff, Air Mshl Sir John Kemball, his naval deputy (RAdm Newman at first, followed by RAdm Woodhead) and his land deputy, Lt Gen Sir Michael Wilkes. Mr Andrew Palmer of the FCO joined the group shortly before hostilities as the Political Advisor. At the end of the briefing and necessary discussion, the Joint Commander made his decisions and gave his orders which were then transmitted to the Staffs through the BMG. Three weeks before the start of the war the Battle Staff within the bunker went onto full 24-hours manning with myself taking the night shift from midnight until midday – effectively a 15-hour stint given the need for detailed handover/takeover briefs from my two deputies, Air Cdre Trevor Nattrass and Brig Philip Sanders. Briefings were held in a specially devised situation room within which large scale maps and charts recorded the most up-to-date information we had on the disposition of all friendly and enemy forces. The day of PowerPoint was yet to come.

Within the bunker this structure proved resilient and effective, as were our lateral dealings with HQ Land and HQ Fleet. Upwards, from the BMG, our dealings with the Commitments Staff in the MOD were less comfortable and I shall return to this matter shortly.

The principle tasks of the BMG were to plan the deployment and recovery of British Forces, the provision of the necessary combat capability for designated air, sea and land operations and the sustainment of British Forces deployed to theatre. As already mentioned, all staff functions were incorporated within the BMG, initially air-focused, but soon to expand to accommodate RN and Army staffs as the size of our contribution to the Coalition grew. Eventually the JHQ planned and implemented the deployments of 45,000 service personnel, 157 RAF aircraft, 100 helicopters, 221 main battle tanks, 92 artillery pieces, and 25 RN and RFA ships. A total of some 15,000 vehicles and 85,000 tonnes of ammunition were transported and during the build-up phase 139 ships were involved in a sea-train over lines of communication that were nearly 6,500 miles long.

Sir Patrick's directive as Joint Commander from CDS was specific in its statement of military objectives. They were to contribute to the complete and unconditional withdrawal of Iraq from Kuwait, and the restoration of the legitimate government of that country while upholding the authority of the United Nations. However, having stated the objectives the directive then ran on for some 28 pages of close signal type including annexes. Apart from spelling out in fine detail exact limits on the achievement of military objectives, it covered everything imaginable from logistics, through POW handling policy to the employment of padres. And the final directive, if I remember correctly, was the 10th serial which did not include the issue of twelve different sets of Rules of Engagement (ROE).

While operational control in theatre of our three Services was delegated to General de la Billière, the JHQ was not relieved of national responsibilities for logistics support, including casualty treatment and evacuation and communications to our air bases, ships and divisional HQ. This also meant that we had to provide communications to, and liaison with, the US formations that our forces were subordinated to and operated with.

Sir Patrick has already made the point that in 1990 we still

possessed sizeable, well-trained and immediately available forces, albeit logistic sustainability was configured primarily for NATO's Central Region and the Atlantic. Moving the focus of military action several thousand miles southeastwards with the necessary communications to allow the exercise of C^2 placed special demands on our communicators who, to my mind, were foremost amongst the unsung heroes of Gulf War I.

They worked wonders, procuring and pressing into service new and often untrialled equipment, adjusting locations and moving people and equipment to meet changing operational circumstances and the needs of commanders and staffs alike. But there was a rub. The vast array of communications no longer channelled the flow of information through a single conduit to the JHQ. MOD had similar and parallel access to information. Not surprisingly, this increased, rather than diminished, the political thirst for information and presented politicians with the opportunity to meddle much more quickly than hitherto in matters of military judgement. I recall that at one stage during the build-up to the war the JHQ was under considerable pressure to install one-to-one communications from the Secretary of State to Brigade Commanders so that he could be kept fully informed of the progress of land operations. Eventually the Joint Commander's argument, that Brigade Commanders in action had more pressing calls on their time, won the day and no more was heard of this nonsense.

Here I should perhaps stress that I am talking with all the benefit of hindsight and from a personal, I stress personal, perspective as seen from the engine room in the JHQ. But there are several issues that always come to the forefront of my mind when I consider national C^2 aspects of Op GRANBY.

Coming so soon after the end of the Cold War when politicians were seeking the so-called 'peace dividend' I should not have been surprised that political interest in Op GRANBY was so intense and pervasive. In particular, the political spotlight, most enthusiastically focused by MOD officials, was trained on resource implications, particularly manpower. The Civil Service was determined that the armed forces would not be allowed to run amok with their demands as had been – allegedly – the case during the Falklands War. Because of the high political profile, the Defence Secretariat had a dis-proportionately large input to decision making which at times paid

scant attention to military judgement and delayed the whole process of implementing the deployment and sustainment of UK forces. Simply put, the time imperative to prepare for war was not appreciated and officials were slow to grasp the military realities of what we were about and the difficulties of deploying such large forces over considerable distances.

This involved the JHQ in an absolutely unending stream of ministerial submissions proposing the deployment of various units and sections – I remember one that involved ten men. On occasion, and at some risk of consequent embarrassment, ministerial endorsement of a submission was anticipated because we could not afford to wait a day longer. And I did get caught with my pants down when I instructed the ship carrying support helicopter engineering equipment to sail without London's permission. Unfortunately the ship ran into bad weather in the Bay of Biscay and had to put into Gibraltar to check the security of its loads. It didn't take long for MOD to question the arrival of a ship in Gib within a timescale that could only have been achieved by a power boat at full throttle. I confessed my sin to the Joint Commander who administered a sharp rap to my knuckles and then protected me from the wrath of Whitehall. On another occasion we were involved in a month-long argument with Whitehall as to whether the RFA *Argus* should be prepared as a hospital ship or a primary casualty reception shop – there are significant differences.

In retrospect I don't think it was until we forced London to consider the disposal of the dead, in particular the possibility of many chemical casualties, that the potential awfulness of what we were about finally struck home. Even so, when hostilities commenced, the revision of ROE to accommodate changing operational circumstances was a running sore throughout the campaign. The staffing process in London lacked any sense of urgency. For example, when I pressed for a decision on a requested and specific ROE change, following the move of Iraqi fighter aircraft from their bases in Iraq to airfields in Iran, I was told the submission was in the Minister's weekend bag. I was very angry. And here I must acknowledge my debt to Sir John Kemball, who recognising the breakdown in communication between myself and the particular official, took on his own head responsibility of staffing all future ROE requests. I should add that as Chief of Staff, Sir John played a key role within the JHQ. He ensured that the BMG

was promptly and precisely responsive to the directions of the Command group while holding special responsibility for Special Forces operations. He also acted as Joint Commander during Sir Patrick's essential travels to and from the Gulf.

Taken in the round, there remains no doubt in my mind that the efficiency of National C^2 arrangements during GRANBY was threatened by an excessively bureaucratic approach that constrained our efforts to prepare for war and caused a great deal of unnecessary frustration and extra work.

Having got that off my chest I will make a final point. Consideration and discussion of C^2 inevitably pays the very closest attention to organisational structures, the allocation of specific responsibilities within the broad definitions of operational command and operational control all with the principle aim of making the command chain as simple, unambiguous and unified as possible. During GRANBY, operating within a multinational coalition of thirty-two nations added the challenge of sustaining a degree of national political control over our forces under command of a foreign national, in this case General Schwarzkopf. Sir Patrick has made the point that while C^2 arrangements for GRANBY may seem rather complicated they worked well because of good personal relationships between Americans and British commanders at all levels. No doubt you will hear more about this later, but let me now return to the High Wycombe bunker.

For eight months, as a staff functionary, I enjoyed the privilege and benefit of witnessing the exercise of operational command at the highest level involving not only the application of leadership and management skills but also, and most importantly, political nous. All officers are expected to develop their powers of leadership and management, so we work hard at cultivating the necessary personal attributes. But during GRANBY I observed at first hand that at the very highest level of operational command there is a step change in pressure which places greater emphasis on certain personal characteristics. While total commitment to the cause and the determination to see it through are self-evident, as is military professionalism of the very highest order, the unremitting pressure of GRANBY over eight months stressed the importance of stamina and resilience. A considerable reserve of mental stamina was essential in

order to be able to master both concept and detail, and to maintain concentration over long periods, no matter how many diversions there were. And one needed a similar degree of resilience to cope with these diversions, which modern communications guaranteed came thick and fast – and principally from unwelcome quarters.

As an amateurish military historian I have often read about the aura of calmness traditionally associated with successful military commanders of the past. When the heat is intense it is essential that those placed in positions of high command can sustain calm deliberation which differentiates precisely between the essential and the not so essential. Without this capacity, the vital senses of balance and proportion can be lost as it is so easy for molehills to grow into mountains under the pressure of vested interests whether they be political, military or economic. Singularly they may be containable but sometimes they can come together to form a tidal wave of pressure that may overwhelm all but the very strongest of character and personality.

Op GRANBY involved our armed forces venturing into new and unfamiliar territory, within a disparate coalition of nations, against an unpredictable and heavily armed foe. The stakes were high and the exercise of operational command within the JHQ required leadership by example of professionalism, stamina, resilience, powers of concentration and calmness – and, dare I say, good humour. We got this in far more than fair measure from Sir Patrick and I am delighted to have this opportunity of saying so with these words to be placed on record within the Journal of the RAF Historical Society.

DEVELOPING THE HEADQUARTERS IN KINGDOM

Air Mshl Ian Macfadyen

Air Mshl Macfadyen joined the RAF via Cranwell in 1960. He began his flying career on Lightnings before becoming a QFI and then switching to the Phantom and commanding Nos 29 and 23 Sqns and RAF Leuchars. Having spent some time at the MOD in OR posts, he was in Saudi Arabia for much of 1990-91. Following a stint as an ACDS, he returned to the Kingdom in 1994 to spend four years as Director General of the Saudi Armed Forces Project (Al Yamamah). Since retirement in 1999 he has been inter alia Lieutenant Governor of the Isle of Man, National President of the Royal British Legion, Inspector General of the Royal Auxiliary Air Force and is currently Constable and Governor of Windsor Castle.

You have heard about the Command and Control arrangements in the UK and between there and the Gulf. Developing the Headquarter arrangements in-theatre was somewhat more complex. Indeed, I think it fair to say that Gulf War I was one of the most complex conflicts in history. It was a battle between Iraq and a United Nations Coalition, except that the UN did not exercise practical command from either New York or in-theatre. The build-up to war eventually involved thirty-two nations, with the British contribution being just over 45,000 personnel. Some of the smaller national contingents came under our umbrella. For example, the United Kingdom had support, in one way or another, from Hungary, Kuwait, New Zealand, Norway and Sweden.

You have heard from Sir Paddy Hine that, to accommodate political sensitivities, the leadership was a joint United States and Saudi affair. In practice, inevitably, it was General Norman Schwarzkopf who exercised overall command because he had both the wherewithal represented by the scale of the US forces that were committed and practical experience of war in both Vietnam and the ill-fated Grenada affair in 1983. In general, US forces in-theatre were about ten times the scale of those of the UK. Since the British contribution was one of the largest, US dominance was indeed total.

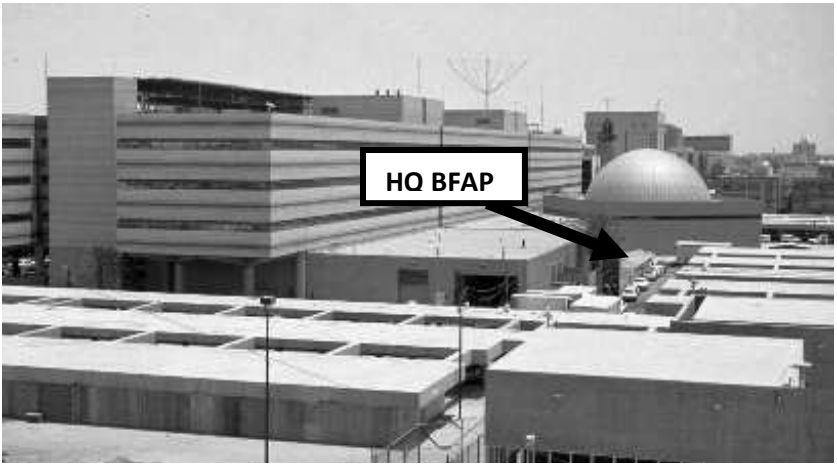
The Coalition's in-Kingdom operation was directed from the Saudi Ministry of Defence and Aviation (MODA) building. This magnificent structure is rather like an iceberg; much of it is underground in an enormous bunker whose corridors alone are at least twenty feet wide. Besides MODA, the other in-Kingdom headquarters included the Royal Saudi Naval HQ and HQ Royal Saudi Air Force (RSAF) – again no expense spared. The infrastructure in Saudi Arabia was on an equally lavish scale and could therefore easily cope with the rapidly developing expansion of forces, as exemplified, for instance, by the sheer size of the port of Al Jubail, south of Kuwait.

As far as the British were concerned, the initial deployment of aircraft took place in the first week of August, under the command of AVM Sandy Wilson as Commander British Forces Arabian Peninsula (BFAP). With the USAF moving into the RSAF HQ in strength, the UK had to fend for itself as there was no extra space available, so more modest accommodation had to be found. It turned out to be a small building, not unlike the Seco huts that used to grace RAF stations from the 1940s until well into the '70s, that soon became known as 'The White House'.

It soon became clear that a combined arms force would be needed to eject Saddam from Kuwait and the 7th Armoured Brigade was ordered to the Gulf. With this Brigade deploying, a broader Headquarter element was required in Saudi Arabia. This initially consisted of a small established cell at High Wycombe, commanded by a lieutenant colonel, that had really been designed to handle a national overseas operation, not an international one. The speed of development of everything in Riyadh meant that finding a place for this already expanding headquarters was no easy matter, especially as the Saudis by now found themselves swamped with requests of all kinds from an increasing number of nations. The solution, in September 1990, was for HQ BFAP to move into the US Marine Corps HQ in Riyadh, a logical step since, you may recall, the early idea was that the 7th Armoured Brigade would provide the heavy armour that the United States Marine Corps lacked.

Inside this twelve-storey Marine HQ, there was just sufficient space for the steadily expanding British Headquarters. At the beginning of October, Lt Gen Sir Peter de la Billière was appointed to command the growing British forces and gained the title of

The HQ for the British contingent was originally accommodated in 'The White House', which was located alongside, and dwarfed by, the vast RSAF HQ building.



Commander British Forces Middle East (CBFME). By now, in order to make HQ BFME a bit more 'purple', an RAF group captain had been appointed as Chief of Staff. His problem, however, soon became apparent – he was first among equals, with the colonel and the captain RN who had been appointed to head the individual Service elements within Riyadh. Such an arrangement was never going to work with

In January 1991 most of HQ BFME relocated to the more palatial offices previously occupied by British Aerospace.

any ease and by the time that AVM Bill Wratten arrived in Kingdom, to take over from Sandy Wilson, things were not developing well.

At the time, I was working in the Ministry of Defence as an air commodore, in a tri-Service role and due to be posted. Since I did not greatly relish my proposed new appointment, I eagerly volunteered for the Gulf, having no idea of how matters were developing. By sheer good fortune, I thus found myself catapulted into an entirely different world as the new Chief of Staff in HQ BFME, working within the USMC HQ, and alongside the offices of Peter de la Billière and Bill Wratten.

With the announcement in November that the 1st British Armoured Division was to deploy to the Gulf, even more HQ space was clearly required. This extra element was forced to move next door to yet another HQ. This was far from ideal, so we set about finding a new and entirely separate building in Riyadh. The former British Aerospace Headquarters in Kingdom looked perfect and we set about negotiating to move in, with some detailed internal design work going on in parallel; it was now well into December 1990. However, we did not obtain final Saudi agreement to move into this fine building until

8 January. Work began immediately. While the structure of the building was sound, the fixtures and fittings were somewhat dilapidated and a great deal of repair and restoration was required. Fortunately, once authorisation is forthcoming, things can move fast in Saudi Arabia. An army of civil contractors arrived, and we were ready to move on 22 January, by which time the air war had already been under way for nearly a week. Moving a large Headquarters during war was an interesting experience!

Coalition warfare was new to us all, of course, but with a reporting chain stretching all the way back to High Wycombe for all matters, it might seem logical that all British elements in-Kingdom would come under one roof. But that would be to misunderstand the reality of the manner in which the war would be conducted. In short, while it is easy to say that 'TACON of UK forces would be under CENTCOM, although politically it was a joint US/Saudi affair', this meant that the C^2 'wiring diagram' was quite complicated. But – it worked.

In practice HQ BFME was principally there to co-ordinate in-Kingdom support of British forces, on land, sea and air. On land, this meant that all supporting elements of ground forces were within my Headquarters. RN ships at sea are largely self-supporting, of course, so I had a much smaller Naval element, under a captain RN. With the RAF element well established in its own 'White House', it was only really necessary to provide sufficient co-ordination with them to ensure that General de la Billière was kept well informed on any air issues and we found that a small RAF team under a wing commander embedded within my staff was adequate for this.

As the pre-war political scene developed, more and more nations joined the Coalition. Absorbing thirty-two national contingents within one command was not easy, although many of these contingents were confined to providing supporting functions, as distinct from participating directly in operations. For example, we were very worried about casualties. The UK did have mobile hospitals deployed in-Kingdom, but with all available reservists already mobilised, we asked for help. The Swedes offered a mobile hospital, under UK command; this was established in Riyadh, and ready for use by mid February 1991.

Battlefield casualty evacuation was also a potential problem, particularly as RAF C-130 and helicopter assets were already fully

The RAF Field Hospital at Tabuk. The Army had a similar facility at Al Jubail and another was established at Riyadh by the Swedes.

committed in support of UK operations. The RNZAF offered two C-130s that were quickly deployed to King Khalid International Airport, working with the RAF Commander there. A wing commander from New Zealand was embedded within my RAF element at HQ BFME. In the event, Coalition casualties were extraordinarily light. The Swedish hospital was therefore assigned to looking after Iraqi casualties, and the care they demonstrated was truly moving. Similarly, the New Zealand C-130s were absorbed into the air transport force and, as invaluable additional assets, they were used extensively on routine intra-theatre tasking.

The manner in which the US led the joint command in-Kingdom required close cooperation with Saudi, British and French commanders. I was much involved in discussion with my French opposite number on issues of mutual interest. And while Egypt, Kuwait, Syria and the other members of the Coalition made national decisions about the roles that their forces would play, they did not play a major part in the overall command system. The day-to-day command arrangements were conducted via a series of meetings, held

in various different parts of Riyadh. I personally attended up to five formal conferences a day during the conflict, including a series of daily mid-morning Coalition conferences, attended by all interested parties, that began in December 1990. An issue that attracted a great deal of attention at these early briefings was the command and control arrangements for SAM units. RAF Regiment experts were flown out to Saudi Arabia to brief Coalition Commanders on procedures such as 'Weapons Tight' and 'Weapons Hold', concepts that were quite unknown to, for example, the air defence units deployed by the Egyptian Army with their Soviet-built SA-3s!

Another aspect of command that I should mention is communications. Saudi Arabia had a robust telephone system but *secure* communications were another matter altogether. The USAF brought their own secure system with them, and RAF basing was initially in large measure dependent upon the field location of such communications, most especially if the Air Tasking Order was to reach squadrons in a timely manner. The US Navy had its own secure communications net but this was incompatible with that of the USAF. This may sound surprising today but in 1990 the centralisation of the control of air assets was alien to the US Navy whose doctrine was one of de-centralisation. After some early friction on this matter, General Horner (COMCENTAF) and his US Navy counterpart worked things out, and the USAF system was installed on the major vessels of the Coalition fleet.

On the intelligence side, secure communications were again a major problem, but more than that, each of the US Arms had its own methods of interpretation and practices. So bad were things, in the view of one RAF squadron leader, a photographic interpreter working on CENTCOM's staff, that he personally set about sorting matters out. His brilliant work enabled adequate Battle Damage Assessments to reach General Schwarzkopf in a relatively timely fashion, with formerly disparate Intelligence Officers all now singing from one (British devised) hymn sheet.

It is hard to believe today that in 1990, Windows-based computers simply did not exist. Nevertheless, this was the first major conflict in which computers did play an important part, although inter-connectivity was often primitive by the standards of today. As you will hear later, the distribution of the daily Air Tasking Order (often

While this is a familiar image today, it was all very new in 1991. Gulf War I was the first major campaign to be fought with the assistance of computers.

running to over 700 pages) provided some real challenges. Nevertheless, I think it fair to say that the first Gulf War represented the most successful effort up to that time to integrate, at low level, all elements of command and control into a unified and reasonably near real-time effort. At the same time, many problems emerged because we had only just begun the transition from a focus on East-West conflict to one of regional conflict. Many key command and control systems and technologies for the Air/Land battle were not yet deployable, or were in a state of transition.

For me, Gulf War I was an extraordinary personal experience and I was very fortunate, not only to have been called to the Gulf, but also, after the war was over, to have taken over from Peter de la Billière as CBFME and thus to have had the rare privilege of exercising tri-Service command.

LOGISTICS SUPPORT

Air Chf Mshl Sir Michael Alcock

Commissioned into the Technical Branch in 1959, most of Sir Michael's early career was within Bomber Command. In the later 1970s he was OC Eng Wg at Coningsby (Phantoms) before commanding No 23 MU. Following appointments at HQ Support Command, the MOD and Bracknell, he was AO Eng at High Wycombe during Gulf War I, subsequently becoming. Chief Engineer, AMSO and, ultimately, the first AOCinC Logistics Command. Since retirement in 1996 he has worked as an aerospace consultant and been involved in the management of the RAF Benevolent Fund and of Princess Marina House.

Casting one's mind back to the summer of 1990 requires a health warning as what I have to say depends largely on fading memory. Few authoritative logistic sources exist to give due historical rigour, although this Society's seminar at Brampton in October 1997 was one helpful source, as were my notes from countless meetings at the time, together with recollections from several colleagues who served on my staff.

I would also borrow a thought from Lord Tedder who wrote, in his autobiography:[1]

> 'I mean to record the course of events as I saw them. I shall be as objective as I feel it possible to be, but I have no intention of departing, for any reason, from my own honest opinion as to events and personalities.
>
> So often, people make a great play about being completely unprejudiced. Frankly, I am completely prejudiced.'

Another quote, this one, from *The Supplement to the London Gazette* of 29 June 1991, reminds us that 1 Armoured Division's daily logistics needs in Op GRANBY:

> '. . . were of the same order as those of the whole of 21 Army Group in the early part of Operation Overlord, the D Day landings in 1944.'

I have failed to find any comparisons of RAF logistic effort, as the whole subject of the 'Logistics of Air Power' is all too rarely studied, but suffice to say that this was a very big logistic task and absolutely fundamental to the success of the operation.

My staff duties as AO Eng at HQ STC covered all aspects of Engineering and Communications – primarily responsibility for maintenance and engineering practices as they affected safety and airworthiness. The command's supply function was subsequently added to my duties which led to support management tasks for the mature aircraft types.

For the duration of Op GRANBY I found myself eventually cast as the DCOS (Support) but today I shall confine myself to examining, from a purely RAF perspective, just five facets of my responsibilities:

- Aircraft preparation
- Weapons
- Fuel
- Movements
- Fleet availability

But logistics is all about planning and about detail so, before I deal with these, I should sketch in the background.

The Decline of Mobility and 'Options for Change'

Air power is, by definition, a mobile force yet by 1990 our primary combat aircraft, the Tornado – which had been designed purely for Northern Europe – was firmly wedded to very well-found, hardened Main Operating Bases (MOB). Engineering support enjoyed extensive second-line workshops to deal with engines, radars and avionics – all backed up by in-service third-line repair bases. Aircraft systems were generally pretty unreliable and our personnel and support resources were such that meeting a peacetime flying training programme was not always an easy task. We planned to fight from these MOBs and were provisioned for a maximum of thirty days of intensive operations, so within that specific context we knew the limits of our sustainability.

That said, the 'Options for Change' Defence Review of 1990, which aimed to realise a 'peace dividend' in the wake of the Cold War, did not bode well for the future, although the Kuwait crisis put

things on hold for a while. A major campaign in the Middle East had not been high on our list of contingencies, however, so dealing with it inevitably called for a great deal of 'hot planning'.

The first week in August saw the HQ shift into top gear and we quickly came to terms with working in our very recently commissioned PWHQ bunker and learning to enjoy the close working relationships fostered by being incarcerated underground for long periods. Each staff component had a functional cell – mine being the Logistics Control Centre (LCC), that was continuously manned from 6 August – complemented by frequent daily gatherings of the Battle Management Group (BMG) and Command Management Group (CMG), meetings that directed the priorities and the evolving plan of action.

My notes from the first day's BMG meetings on 8 August reflect the initial outline as follows:

- Jaguar squadron on 12 hrs notice to move.
- No base identified for Jaguar – probably Oman, along with AAR and MPA.
- Twelve Tornado F3s at 12 hrs notice to move from Cyprus – probably to Dhahran later, although that might change.
- Six Rapier Fire Units would require twenty Hercules loads.
- Plan for two days of weapons, balance to follow – initially estimated at between seven and nine Hercules loads.
- Tactical Communications Wing would need three Hercules loads for mobile satellite terminals to set up command and control networks.
- Skyflash missiles had a compatibility issue.
- IFF compatibility was an issue – Mode 4 IFF was essential.
- Liquid oxygen might be a problem.
- Fuel would be a host nation responsibility.
- Jaguar was going to need air conditioning mods, urgently.

Despite the understandable uncertainty over basing, the initial task did not pose too many problems. Tactical Supply Wing (TSW), on exercise in Cyprus, was ordered to Saudi to provide support for Tornado and Jaguar deployments. OC TSW (Wg Cdr David Bernard) was given authority to use his AMEX card to buy portacabins and

furnishings for ops accommodation and domestic facilities for deployed squadrons.

Since our Jaguar squadrons routinely deployed to Norway or Denmark on NATO exercises, they had current Air Staff Tables and Flyaway Packs (FAPs) of spares. A Jaguar squadron deploying for war could run to between 500 and 600 people which, with their supporting ground equipment, could involve between twenty-five and thirty C-130 sorties – but this did *not* include any heavy weapons – the all-important bombs!

Aircraft Preparation

By the end of a busy first week it was clear that the Tornado F3s from Cyprus were going to have to be replaced on roulement with upgraded aircraft fitted with an extensive package of modifications. Engines needed rescheduling for a hot climate; there were issues with Skyflash and AIM-9L Sidewinders; we needed to fit *Have Quick* secure radios and modified IFF. All of this was going to need an urgent coordinated, fast-track modification programme to which we later added 'stealth' which we attempted to achieve by gluing radar absorbent tiles in the air intakes. Other additions included improvements to the Radar Homing and Warning Receiver and the installation of new Phimat chaff and flare dispensers, which required exchanging engine doors with the production line at Warton. It was a major programme and we eventually modified forty aircraft.

As more types of aircraft were added to the order of battle – Tornado GR1s and GR1As, some from RAF Germany; Puma and Chinook; AAR, both VC10 and Victor; Nimrod MPA and R; and the Hercules and TriStar were all committed – we soon needed a dedicated requirements team to keep track of the never ending stream of Special Trial Fits (STFs) for virtually every type in our ORBAT. The staff were kept very busy sorting out how best to handle a massive additional workload that would soon have an impact on almost every RAF squadron and support facility. Whilst industry excelled itself in helping with all of these urgent requirements, as did MOD PE at every level, our technical personnel at main bases, as well as the maintenance units at Abingdon and St Athan, soon became used to round the clock shift work.

We are going to hear from Colin Cummings about the Jaguar

enhancements that transformed that aeroplane's operational capability but, as you listen to his presentation, do remember that a similar story could be told for most of the types we deployed. The Nimrod,[2] for example, had numerous operational mods fitted in short order, as did the C-130; the Buccaneer[3] set the record having been given just 72 hours to deploy to the Gulf, although they had been told to 'prepare to prepare' before that.

I do recall having pervasive concerns over the sustainability and reliability of all of our aircraft. How long would this operation last? At what rates of flying and weapon consumption? Would we achieve the necessary availability of combat ready aircraft? Would we need to defer scheduled maintenance programmes to achieve intensive flying rates?

Engine reliability was a particular worry, as we were unlikely to have any repair facility available in-theatre, so the prospect of running out of engines became a real possibility[4]. Rolls-Royce were equally worried and very proactive in setting up a dedicated support organisation at Bristol. Apart from being an excellent source of advice and information on the RB199, the company contacts were vital to sort out problems when the radar absorbent tiles being trialled on the Tornado F3 became detached in early flight tests. For a small flexible tile to come loose does not sound like much of a problem, but we did experience a couple of engine failures and Rolls-Royce were concerned at the risk of provoking an uncontained engine failure, which would have been disastrous. It was reassuring to be able to deal with the company at high level to get the best possible advice.

Helicopter engines were a particular problem, with the potential for compressor and turbine failure due to the ingestion of sand. The Puma already had a sand filter but we soon discovered that it was not working properly and, despite much in-theatre work to sort it out, their engine failure rate fell from a norm of some 400 hrs MTBF to just 40.[5] The Chinooks all required an extensive modification to fit sand filters before being dismantled for air transport.

As the order of battle grew, so more bases became involved, further complicating the logistic plot, not to mention the demand for manpower, especially the skills needed to implement the various mod programmes – electrical trades were particularly hard pressed. Whilst industry played its part to produce the bits for innumerable new

requirements, the majority of installation work for all STFs was undertaken by service tradesmen. Those were the days when our air force still had extensive in-service support capabilities, with third line at St Athan, Abingdon and Sealand plus on-base second line, so we did have the manpower – but not necessarily in the right places.

Manpower allocation was eventually controlled by a so-called Gulf Emergency Planning Aid that compiled detailed manpower requirement at each deployed base across all trades, indicating whether the manpower was to come from a formed unit or the Service at large. An early decision was to close down the Buccaneer major servicing line at St Athan, which initially created enough headroom to get more engineering tradesmen into Lyneham to keep pace with the maintenance demands for a three-fold increase in C-130 flying already being achieved for August. In retrospect that was a good decision, as the C-130 fleet was kept very busy long after the end of the conflict.

As more types were added to the ORBAT the logistic plot thickened. The MOD were pressing for a written plan for Logistic Support, which seemed sensible enough, but the reality was that the plan was changing every single day. Especially so with the first visit on 17 August from our Army Logistic colleagues from HQ UKLF. Each Service looked after its own needs, but it quickly sank in that Army freight was going to swamp the available airlift and pose difficult questions of resolving priorities. At much the same time, the pace of the airlift quickened, driven by our own weapon out-loading by air. That in turn, led to lengthy discussions about rates of effort, types of weapons, clearances, tail assemblies, fuses and so on, as well as confronting the difficulties involved in moving more than 100 JP233s, each of them 21 feet long and weighing more than 2 tons.

Weapons

Moving weapons requires an out-load plan, somewhere to store them in-theatre and experienced users. We had precious little experience of any of this; nor did we have first-hand recce of the bases. There was quite a bit of host nation bureaucracy to overcome too, because explosive storage was a considerable problem at every base, Muharraq being the most difficult. In fact the initial weapons storage facility for units based at Bahrain was aboard one of our chartered ships, held off the Omani coast – otherwise known as the

Bomb storage at Muharraq.

'Muharraq Standby Bomb Dump'!

The initial out load of 1,000 lb bombs by air quickly swamped priority freight for all three Services, which led in turn to extensive chartering of civil freight aircraft. Some JP233s went by air, but most were eventually moved by sea from Bremen and, for some obscure reason, they could only get to Bremen from the 'clutch bases' by road, rather than rail, which complicated the issue. Weapon out-loading continued for many months and it was still going on during the fighting. By 17 January 1991, when the air campaign actually began the RAF's weapons cupboards, in both the UK and Germany, were already starting to look a little bare.

The low-level runway disruption phase of the air campaign was quite short, so we had plenty of JP233s. But the subsequent switch to medium level bombing meant that we were soon using 400 thousand pounders a day, that's 200 tons a day! Warheads were not the only issue. Free fall bombing brought numerous changes of plan that meant changing the weapons that had originally been loaded, so frequently that we began to run short of the ancillary parts for tails and arming

safety devices.[6] We then found that we had more bombs than MACE lugs (Minimum Area Crutchless Ejector – small devices that are screwed into a bomb to permit it to be fastened to the weapon carrier) which was another complication. Industry had a contract to supply 20,000 MACE lugs but, with no reliable forecast of when they might be delivered, we made our own at St Athan!

Some of our fuses, like the multi-functional Fuse No 960,[7] were much in demand but they were pretty new to both armourers and aircrew. Early use of this fuse indicated that an aircraft could be damaged by premature detonation from its own fragmentation envelope. Much urgent investigation was needed to understand the phenomenon, including taking a metal fragment from a Tornado that had suffered in-flight battle damage. When forensically tested at RAE Farnborough that sample proved to be the same composition as our forged bomb casings; indeed it was most probably matched to a particular bomb case manufactured during World War II! – which proved that the battle damage had been self-inflicted. Longer arming times, consistent with medium altitude delivery for that particular fuse, solved the immediate safety problem. Post war investigation subsequently confirmed that one of our aircraft had indeed been lost to this cause.[8]

New weapons and fuses were much in demand to keep pace with changes in targeting policy, and Boscombe Down was kept busy working on clearances for all kinds of equipment known to be available from Allied sources, as well as some of our own configurations that were being used under ‘service deviations’ pending full clearances. A notable example was the, then very new, ALARM defence suppression weapon, which had not yet been introduced into service. It seemed sensible to speed up the formal clearance process by using it in anger – with some success I believe.

The most significant development was the switch to precision guided weapons – PGMs – specifically, the Paveway. Ten days into the 42-day air campaign, the Buccaneer, with its obsolescent Pavespike designator pod, was hastily added to the ORBAT, with very effective results. Pavespike could only be used in daylight, but we learned that Boscombe were trialling Ferranti’s new Thermal Imaging Airborne Laser Designator (TIALD) pod. I spent a hectic day at Boscombe on 23 January and, after a swift appraisal, that too was

added to the ORBAT giving us an all-weather day/night designation capability for the first time. TIALD arrived at Tabuk just three weeks later, on 6 February, and was efficiently supported in-theatre by a small team of Ferranti technicians. After some initial teething troubles, that too performed extremely well.[9]

Using LGBs thankfully moderated my concern with consumption rates until even these weapons became scarce.[10] My notes remind me that on 11 February – Day 26 of the air campaign – the Joint Commander's predicted weapons tote looked like this:

- LGBs would last until 28 February
- 1,000 lb stock until 23 March
- Fuse 960s until 28 February
- No 114 tails until 5 March[11]
- No 117 tails, and 947and 951 fuses until 24 March[12]
- MACE lugs until mid-March

I vividly remember that the best source willing to let us have more LGBs were the Australians, who were extremely helpful.[13] I seem to recall that a C-130 was at RAAF Richmond being loaded with GBU-12s as the ceasefire was declared.[14]

By the end of the war almost every useable 1,000 lb bomb in our inventory was either used, in-theatre or in transit by sea.[15] We still had small residual stocks in Belize and the Falklands but sustaining the rate of use during the whole 42-day air campaign was only achieved by a narrow margin. The limit of our logistic sustainability was definitely in sight! [16]

Aviation Fuel

The vital commodity of fuel was no less of a worry. In spite of being assured early on that the host nation would co-operate, it soon became evident that the local authorities were actually quite unco-operative and supplies at most locations were problematic with tenuous resupply, unprotected facilities, dubious contingency plans and a potentially unreliable Asian, Eurasian and Filipino labour force. None of which was a sound basis for a wartime situation.

At Muharraq, for example, where we eventually had more than fifty combat aircraft, there was a single 16" pipeline supplying an airfield hydrant system which had only one dispensing point. At

A pillow tank farm somewhere in Saudi Arabia.

Tabuk, we were entirely dependent on resupply by road from Yanbu on the Red Sea, some 800 kms away, with contractors' bowsers doing a 34-hour round trip to keep the system topped up.

To give ourselves a reasonable contingency holding, we deployed our entire stock of Emergency Bulk Fuel Installations (EBFIs), borrowed heavily from the Army and placed orders with industry for more tanks. Altogether we used 130 pillow tanks, split between the five locations, which was almost three times our entire provision for 'transition to war' in Europe! None of this could have been achieved without the expertise of Tactical Supply Wing who also made a unique contribution to keeping the support helicopter force supplied throughout their operations.

We will hear more about the helicopter operation this afternoon but, for the moment, suffice to say that TSW sustained the entire tri-Service fleet of Chinook, Puma, Lynx, Gazelle and Sea King helicopters using twenty-one different refuelling sites, in support of rapidly advancing forces on a scale never even envisaged in a European context. It had been a demanding test of their training and resilience, a test which they passed with flying colours and, in the process, demonstrated their indispensable value to the RAF.

Movements

The 'Movers' naturally played a key role in getting the force

established in-theatre. Daily deliberations in the Logistics Control Centre determined what was to be moved by air and allocated priorities to everything that was deployed. In total that amounted to some 46,000 tons of freight and 45,000 passengers. Brize Norton and Lyneham were both stretched to the point where the freight backlog eventually peaked at 1,600 tons by 23 January. This, despite a daily airlift in excess of 500 tons – a *daily* rate that equated to the peacetime *monthly* rate for the whole RAF air transport force.

Brize Norton ran out of space to build freight pallets and the pressure was relieved by doing the job at the Army supply depot at Bicester, from where loaded pallets were sent direct to Gatwick, Stansted, East Midlands and Heathrow airports to be moved by civil charter flights.

Most freight was flown into Dhahran and Riyadh, but almost everywhere the quantity, quality and serviceability of air cargo handling equipment was inadequate. We were obliged to hire such things as main base transfer loaders and at most locations we were heavily dependent on the goodwill of the USAF, so much so that our in-theatre movers became known as ‘the Borrowers’! Sadly our own cargo handling kit was both obsolescent and very unreliable, exposing a critical weakness in the working of the air bridge from the UK. Clearly, airlift is not just about aircraft – cargo handling matters just as much!

As each deployment base was established, movements handling became more difficult. Since UKMAMS was stretched to the limit, No 4624 (Movements) Sqn, Royal Auxiliary Air Force, was deployed. Great credit must go to the movers for getting vast quantities of freight into theatre, but the sheer volume created massive dumps, notably at Al Jubail (Baldrick Lines, organised by the Army), which meant that kit was often lost.

Tracking cargo was near impossible, partly because of the volume, but the situation was aggravated by a crude system of colour coding by destination, and our manual processing procedures proved to be woefully inadequate. All too often an item was mislaid in transit with the result that a replacement had to be ordered, the consequent duplication adding a further self-inflicted inefficiency. Getting the right bit to, the right place, at the right time was simply beyond our system.

Rows of vehicles, containers and equipment on the dockside at Al Jubail. Keeping track of all the British kit and getting 'the right bit to, the right place, at the right time was simply beyond our system.'

After the war all of this experience did result in the acquisition of new cargo handling equipment and, at long last, proper recognition of the vital importance of tracking critical assets whilst in transit. This eventually led to the development of systems to solve the problem. We have come a long way since then. Today even a modest package sent by the Royal Mail comes with its unique tracking code!

Availability

There were eventually 157 aircraft taking part in the campaign, plus air transport. In all we reckoned that, including attrition reserves, nearly 300 aircraft were prepared for Op GRANBY.[17]

To my great relief no insurmountable reliability problems were experienced. For the most part systems performed up to, and often beyond, expectations and serviceability was maintained at a consistently high level. I do not have actual wartime availability figures to quote but the Tornado certainly achieved at least its peacetime rates – around 65% –whilst the Jaguar force excelled itself, often achieving 100% availability. My notes record flying rates for

Tornado F3 at roughly double peacetime training rates, with the GR1s achieving three times the normal rate.[18] We had decent spares provision for the Jaguar, with its pre-prepared FAPs, and we cobbled together spares packs for the Tornado from scratch, helped by fact that we were eventually able to make some use of RSAF avionic repair facilities.

We did have some problems with EW equipment, notably Skyshadow deception jamming pod and the RHWR, particularly on the GR1As, possibly because these were systems that attracted less attention in peacetime.[19] RHWR failures took on a high profile as Lord Weinstock, Chief Executive of GEC, took a close personal interest, so help was at hand!

That said, despite the long resupply chain, overall system performance was very satisfactory, especially given the harsh operating conditions, and it reflected great credit on the considerable efforts of ground crews and support personnel.

Lessons Learned

I have not had time to cover the whole range of logistics – or communications.[20] While communications is a tri-Service, central, task, all our links depended on a variety of RAF units and on the RAF's engineering skills. In that context, I should mention, in particular, the contributions made by the Tactical Communications Wing, the Skynet satellite control centre at Oakhanger and the RAF Signals Engineering Establishment. Secure telephones and fax were all RAF-engineered 'firsts'. All of our logistics depended on computers which required reliable data streams back to UK, as did the wonderful ASMA. What would we have given for today's 'wired world'?

My main conclusion is that in-service expertise had been crucial to logistic success in this campaign, as was the fact that we were fortunate to have had enough time to adapt our aircraft and, working closely with industry, to devise and implement innovative solutions to problems, without too many overriding financial constraints.

Yet there is little doubt that Op GRANBY showed us that Logistics Support needed to change beyond all recognition. As a result of the Cold War, and our almost total commitment to NATO, we had become a static air force, too firmly wedded to the Main Base.

Nevertheless, we had demonstrated that we still had sufficient flexibility for us to have been able to project air power in the shape of a balanced force in an allied operation.

However, in doing so:

- We had taken too much kit;
- we were unable to track critical items,
- and we had lost far too many of them.

Above all, the experience had convinced me that, in order to exploit the inherent flexibility of air power more effectively, we needed to reorganise, to bring together, all in-service support disciplines *and* industry. Surely it should be possible to create better working arrangements – arrangements that would capitalise on what we had learned.

Notes:

[1] Lord Tedder; *With Prejudice* (Cassell, London, 1966).

[2] http://www.raf.mod.uk/history/RoyalAirForceNimrodsintheGulf.cfm.

[3] http://www.raf.mod.uk/history/GulfWarBuccaneerOperations.cfm.

[4] As at 24 September there were 144 engines in-theatre. 36 RB199 Mk 104, 48 RB199 Mk 103, 24 Adour, 20 Spey 205 and 16 Conway.

[5] See Gp Capt Mike Trace's presentation on Support Helicopters elsewhere in this Journal.

[6] Every time a bomb was loaded the armourers fitted a new set of consumable parts, which were provisioned at one set per weapon. Thus an unforeseen consequence of changing decisions on targeting was that we ran short of these 'single use' ancillary parts.

[7] As at 13 February industry was producing Fuse 960s at a rate of 75 per day.

[8] http://www.raf.mod.uk/history/RAFTornadoAircraftLosses.cfm. During the early hours of 24 January 1991 Fg Off S J Burgess and Sqn Ldr R Ankerson flew on a mission to attack an airfield in SW Iraq with 1,000lb bombs from level flight at medium altitude. Shortly after having released their weapon load as planned there was a large explosion behind the aircraft and the crew thought they had been hit by a surface-to-air missile. They turned towards the Saudi border with flames spreading along the aircraft wings. The aircraft became difficult to control and the crew prepared for ejection, which they did once control was finally lost. The crew suffered very minor injuries as a result of the ejection and descent. They were both captured and held in captivity until the cessation of hostilities (*see RAFHS Journal No 56, pp 133*-140). The wreckage of the aircraft was found and briefly inspected by the investigating team; the Accident Data Recorder was recovered for analysis. Shrapnel fragments recovered from the aircraft wreckage were analysed and indicated conclusively that premature detonation of one or more of the 1,000lb bombs had

occurred, damaging the aircraft to such an extent that the crew had no option but to eject.

[9] Two TIALD pods, 001 and 002 were available. 001 experienced 100% availability whilst 002 achieved 98.2%. The pods flew on five different modified aircraft, operated around the clock by ten different operators, achieving 229 direct hits over 18 days, an unprecedented success rate. Source *TIALD – The Gulf War*, GEC Ferranti Defence Systems, courtesy AVM George Black.

[10] Thousand pounder consumption dropped to 128 per day on 12 February.

[11] The 114 Tail Unit is fitted to the 1,000 lb bomb for 'slick', ie ballistic, delivery.

[12] The 117 Tail Unit is fitted to the 1,000 lb bomb for retarded delivery, although ballistic delivery is a secondary option. The Fuses Nos 947 and 951 are both tail fuses, intended for ballistic and retarded delivery, respectively.

[13] No 1 Central Ammunition Depot, RAAF, which I visited as Chief Engineer on 24 March 1995 in order to thank the staff in person.

[14] The American GBU-12 Paveway II LGB is a US Mk 82 500 lb bomb fitted with a nose-mounted laser seeker and tail unit with moveable fins to permit it to be steered. The GBU-16 is similar but uses a 1,000 lb Mk 83.

[15] Total consumption had been of the order of 3,000 tons of ordnance including: 100 JP233s; 6,000 thousand pounders, of which 1,000 had been LGBs; more than 100 ALARMs and 700 CRV-7 air-to-ground rockets.

[16] We had used about 5,000 bombs, approximately 2,500 tons, by 18 February.

[17] As at 14 November, the numbers of aircraft that had been earmarked to be modified as required to prepare them for operations included: forty Tornado F3s; sixty-four Tornado GR1s; twenty-eight Jaguars; ten Nimrod MPA; two Nimrod R; nine VC10s; eleven Chinooks and fifteen Pumas. More were added later, including, for instance, Chinooks dedicated to Special Forces, TriStars, C-130s and additional Tornado GR1s as attrition replacements. By 31 January sixty-eight Tornado GR1s had been prepared plus another twenty as attrition replacements – eighty-eight in all.

[18] The flying rate achieved by the Tornado GR1 was 87 hrs/aircraft/month, compared to 50 hrs/aircraft/month by the Tornado F3s.

[19] Airborne aborts due to failures of EW kit ran at 3.35/100 sorties, the majority, 3.11/100 sorties, being specifically attributable to the RHWR. The Skyshadow's 26 hrs MTBF matched the predicted rate.

[20] Topics that have not been addressed include: NBC kit; desert clothing; tentage; explosive ordnance disposal (EOD); battle damage repair; the provision of secure communications; and many others.

NEW JETS FOR OLD – A CASE STUDY

Wg Cdr Colin Cummings

Colin Cummings served in the Supply Branch for 31 years. After a series of station tours, mostly in the Far East, he spent a significant element of his service involved with IT systems, both within the Supply Branch and in the Directorate of Flight Safety, and eventually became the first officer of the Supply Branch to manage an aircraft Support Authority (the Jaguar). Author of a notable series of books on aircraft accidents, he still holds an RAFVR(T) commission and is a member of the RAFHS Committee.

Following the liberation of Kuwait, the Prince of Wales commented that the Gulf conflict had been a triumph for the logistics support services. The previous speaker described the logistic issues faced by the RAF at the strategic level; my paper will look at how these were addressed at the working level. Of course, as Sir Michael has explained, 'logistics' covered an extremely broad canvas and I shall consider how the RAF dealt with only one aspect – that of the fleets of aircraft that it deployed, most of which required significant modification or enhancement.

Each type had its peculiar support issues and, in the time available, I cannot deal adequately with all of them. I hope, however, to provide a flavour of the whole enterprise by using one aircraft as a case study which will illustrate the sort of challenges faced by all of them. I have chosen the Jaguar attack and reconnaissance aircraft because, the day before the force was called upon to deploy, I began to take over specific responsibility for the Jaguar, as part of the creation of a new multi-disciplinary 'weapon system' approach to managing the support of each of the aircraft fleets fielded by the RAF.

Prior to this, aircraft support had been provided by groups of people who operated in a series of vertical 'stove pipes'. Each of these stove pipes worked – to a considerable degree – in isolation from the others and each one had its own discrete hierarchy and management chain.

Whilst there was some contact between the stove pipes when

required, this approach was inefficient, sometimes ineffective and it was often difficult to understand who had ownership of the whole system. Each of these somewhat insular hierarchies comprised: RAF engineers, in several guises; supply specialists; financiers; contracts managers and post-design service specialists. Industry found this arrangement difficult to deal with and it also produced significant duplication of effort and a lack of clear prioritisation.

The solution was to demolish the stove pipes and create multi-disciplinary teams containing all of the specialists required to support each individual weapon system. In the summer of 1990, the core of the teams supporting most of the operational aircraft was provided by the engineering staff at High Wycombe. Although most of these multi-disciplinary groups – MDGs – were led by the engineer branch wing commanders who had headed the former HQ STC stove pipes, the Jaguar and TriStar were to have a supply officer in charge. For the Jaguar, that was me.

Prior to the initial deployments from the UK, in the second week of August, the RAF Presentation Team was asked by a member of an audience if, in the light of possible hostilities, it was intended to reopen the Ministry of Aircraft Production! The Team Leader patiently explained that, given the complexity of modern aircraft and the long lead-time for their construction, this was highly unlikely, so the RAF would have to fight any conflict with the assets in hand. He might well have added, however, that, in order to enhance their operational capabilities, aircraft would often be modified, as could, and just as importantly, the equipment with which they were fitted. This process of upgrading and enhancement was exactly what happened to many aircraft fleets and it is this process which I shall explore in this paper.

At this stage the Jaguar had been in service for about fifteen years. Having initially been conceived as an advanced trainer, it had eventually materialised as an attack aircraft with a tactical reconnaissance capability. A very senior officer told me that, when it was introduced into RAF Germany (RAFG), it was regarded as having such limited combat potential that it was recommended for the Nobel Peace Prize; that said, it did have a tactical nuclear strike role.

The arrival of Tornado and its deployment to RAFG saw the progressive withdrawal of the Jaguar and by the summer of 1990 the

residual Jaguar force comprised just three squadrons at Coltishall and an OCU at Lossiemouth. There were, in addition, a few Jaguars flying with specialist establishments and a test airframe at Warton that was being pushed, pulled, tugged and squeezed at all hours of the day and night to keep it comfortably ahead of the active fleet leader in terms of its fatigue consumption.

The drawdown from Germany had created a large pool of surplus airframes and there was a rationalisation of assets so that the more capable examples, those fitted with Ferranti's FIN1064 inertial nav/attack system, were allocated to the remaining flying units whilst the others were placed in storage or allocated to training schools. The fleet therefore consisted of two approximately equal groups:

a. The long term fleet – the active aircraft.

b. The short term fleet – aircraft in long term storage or at the training schools, where they were still a valuable source of spares and a hedge against attrition.

Management of the total stock was a little complicated as it was the practice to mix and match wings with fuselages, including those in the short term fleet, in order to minimise the impact of fatigue.

The initial Gulf deployment involved twelve aircraft. They were all to be single-seaters capable of air-to-air refuelling, some configured for attack only, others to have an additional recce option. Generating a dozen aircraft was pretty routine for Coltishall but in this case it was also necessary to see what could be done for aircraft optimised for North-West Europe to adapt them for operations in the Middle East. To a degree, this too was relatively straightforward, as the Omanis were flying the Jaguar International and we had a good relationship with them; indeed a number of our pilots had experience of operating with the SOAF.

Nevertheless, we needed to establish precisely what we could do to make the aircraft better able to cope with the new environment. Furthermore, whatever we did decide to do, we had to do it within three working days, because that was when the jets were due to depart.

The selected changes would eventually be known as the 'Stage One Modifications' and they included: minor changes to the air conditioning and ground cooling systems; the fitting of *Have Quick*

Before and after the application of the ARTF paint scheme.

anti-jamming (frequency-hopping) radios; and provision of an uprated Mk 12 IFF facility in order to be compatible with US forces.

The most obvious modification, however, was the application of an Alkaline Removable Temporary Finish (ARTF) paint scheme. The first ten aircraft were re-sprayed overnight with this 'Laura Ashley pink' finish, which provided much excitement for a bunch of ATC cadets on a summer camp, who were allowed to help with some of the work.

All changes were vetted by a team of specialists at Coltishall – the Jaguar Aircraft Engineering Development and Investigation Team – the AEDIT. Most were instituted using a handy procedure, the Special Trial Fit (STF), which by-passed the lengthy chicanes involved in obtaining a formal clearance. As the twelve aircraft departed for Thumrait via Cyprus that summer Saturday morning (11 August), there were a few hours of breathing space to decide how best to move forward.

For the Jaguar there was plenty of evidence to review and on which to base decisions with a reasonable degree of confidence.

- First, as noted above, the force had worked closely with the Omanis.
- Secondly, there was the 'Jaguar War Measures' paper. This study had been done some time before and although it did not look specifically at the situation that we now faced, it did contain much of value.
- There was also a range of trials, both ongoing and planned, which sought to improve various aspects of the Jaguar and its weapons fit, regardless of the current situation.

A rapid assessment was made of all of the potential additional enhancements and these were then categorised into three principal groups:

- Stage Two enhancements were those which could be developed and installed in time to support a subsequent roulement of aircraft and crews. Of course at this time, nobody had the faintest idea as to when that would take place, so this could only be a best 'guesstimate'.
- Stage Three enhancements consisted of those, possibly more complex, improvements which would require a little longer to acquire, prove if necessary, and install. Enhancements within this group might be available for a second roulement.
- Finally, Stage X represented things for which there was a degree of uncertainty over acquisition or any other factor on which we did not have a firm grasp or which needed approval from elsewhere.

It quickly became apparent that these three stages were not inviolate and individual tasks migrated from one stage to another – fortunately, mostly forwards. A major proposal which never saw the light of day was to fit a refuelling probe to the two-seat Jaguar, upgrade its avionics and then provide it with a thermal imaging and laser designation (TIALD) capability.

The first thing to do, however, was to prepare the crews who would go out to the Gulf if a roulement went ahead. At the same time there was a need to create a pool of additional aircraft to which the ever

Production getting under way – nine 'desert cats' on Coltishall's flight line.

increasing list of enhancements could be applied, once they had been proved and approved. This was a comparatively straightforward exercise and involved recovering three aircraft which, having recently undergone major servicing, had been placed in short term storage at RAF Shawbury. These aircraft were used to fill the gaps left at Coltishall. I should stress, incidentally, that extensions to the periodicity of planned maintenance were always very carefully considered and the rationale meticulously documented.

Next, we needed to work out how to manage the installation of the enhancements and undertake the necessary maintenance to prepare the aircraft for use in the Gulf, whilst allowing the pilots the opportunity to familiarise themselves with the uprated aircraft. As each of the modifications to be incorporated was approved it became necessary to decide how, where and when the necessary work would be done. One early decision was that priority had to be given to those aircraft that

might be required to support the Gulf commitment. That meant that several two-seaters and those single-seaters with a potentially long recovery time, were sidelined – quite literally – they were taken off the maintenance and modification tracks at both Coltishall and Abingdon. The same happened to a small number of single-seaters, mostly those at the OCU, which lacked a refuelling probe.

As some 30% of Coltishall's second line manpower had gone with the first deployment, there was a manpower and skills shortage at the base – a situation that would be aggravated when staff rotated to the Gulf. Support Command played a vital part at this point, as they agreed to suspend major maintenance and low priority modification programmes, in order to take over the second-line maintenance task, which would normally have been the responsibility of Coltishall. That permitted Coltishall itself to become the focal point for the enhancement work, using its residual manpower, suitably reinforced from elsewhere. One obvious source of Jaguar expertise was the OCU at Lossiemouth, so much of its manpower was moved south and concentrated at Coltishall. These arrangements, later called the Jaguar Fast Track Modification Programme, and eventually authorised to embrace twenty-eight aircraft, were soon up and running.

At about this time three serious issues materialised. One could not have been foreseen, but the other two were self-inflicted injuries, one by our own air staff sponsors, the other by the MOD Procurement Executive.

The first problem arose when a Jaguar landing at Lossiemouth suffered a partial main undercarriage collapse because of a fatigue failure to a knuckle joint where the leg joins the axle. This was rapidly dealt with by a fleet-wide non-destructive testing (ie X-Ray) programme, followed by a massive shuffle round of serviceable knuckle joints, including looting the main undercarriage from the 'fly by wire' test bed airframe residing at Loughborough University! As an aside, that little piece of skulduggery cost me a dinner for the head of the university's engineering faculty.

In the second case, the MOD air staff had produced a so-called 'alternative assumption' for the annual costing round. This proposed selling thirty Jaguars and using the funds realised to upgrade the others. The fact that these thirty aircraft comprised the pool of fatigue life and flying hours which we needed to sustain the active Jaguar

fleet to its forecast ‘out of service’ date seems not to have occurred to them. My team had not been consulted and we knew absolutely nothing of this until we learned that the office of Requirements Programmes Air – always alert to any hint of economies – had foreclosed on these potential ‘savings’ but diverted the notional funds elsewhere. The actual consequences of this particularly poorly staffed decision were entirely negative. All that it achieved was that the surplus aircraft on offer remained unsold but no longer attracted the funding necessary to maintain them. In effect, we had thirty fewer Jaguars with which to manage the remaining life of the fleet – and absolutely nothing to show for it in return.

The third case, which for the last twenty-odd years I have believed to have been a deliberate spoiling tactic from within the Procurement Executive, saw the Jaguar programme declared as ‘complete’, which meant that the bi-national agreements were curtailed and we and the French were supposed to go our separate ways on all aspects of the future management of the aircraft. Fortunately, neither I, nor my French counterparts, considered this to have been a smart move and we set up an overarching arrangement which served the Jaguar well for the rest of its days.

There was a further potential setback during the work-up phase for replacement aircrew when a Jaguar was lost in a fatal accident in the Solway Firth. Since it seemed unlikely that there had been an issue with the aircraft, the operational low flying and other training continued apace and the work of modifying and enhancing the weapon system was not affected unduly.

What did affect the upgrade work, and sent the experts back to their slide rules, was a problem with reducing the aircraft’s radar signature. At the time stealth technology was not a major factor in our thinking, although the Americans had made major advances in this field.

For Jaguar there were two programmes. First, the leading edges of the wings and the engine inlet areas were painted with a radar absorbent paint – seven coats for each aircraft, which involved quite a hefty weight increase. As a result, each aircraft had to be weighed and its Centre of Gravity data recalculated before it was flown to check its flight characteristics. This was found not to be a serious concern.

Sadly, the same could not be said for the second innovation, a

The end result, a Jaguar taking off for a sortie from somewhere in the Gulf.

scheme that involved fitting radar absorbent tiles inside the engine air intakes of the Tornado, which was extended to include the Jaguar. The installation process used a method, developed by the Tornado Role Office and the MOD staff, which involved the tiles being glued into the intakes and then held in position by a sort of inflatable mattress while the adhesive cured.

Unfortunately, when the trials Jaguar was flown against sensors at Spadeadam Range, by a Rolls-Royce test pilot, some tiles came off. Both engines sustained some damage, although the aircraft was recovered safely. While our subsequent investigation was focusing on the glue and the techniques for fitting the tiles, my Project Officer asked his Tornado opposite number about their experience. The rather unhelpful response was, 'Funny that – that's exactly what happened to us.'

Manpower, or to be more precise, the availability of specific skills, was under constant review, as were the techniques employed because much of the work was centred on the cockpit area and there was a need to de-conflict tradesmen (there is room for only one man at a time in a single-seat cockpit) and try not to revisit things which had already been dealt with. You will not be surprised to learn that the quality and ingenuity of the AEDIT SNCOs and trade managers ensured that viable schemes were worked out to ensure that all important issues were addressed. Working practices, shift patterns,

skill mixes within the teams and a plethora of other matters were all resolved quickly and effectively.

The ingenuity with which some problems were tackled never ceased to impress me. For example, a machine to wrap cable looms was invented using a bicycle chain, a pedal crank and a wheel. Equipment trays and mounting brackets were designed and manufactured and their robustness was subsequently commented on favourably by the Design Authority.

The first roulement was successfully accomplished in early November 1990 and the work needed to prepare the next changeover began, although as things turned out this was not necessary.

This paper has made no attempt to reflect the Jaguar's operational record but when the aircraft returned to the UK – to an emotional welcome I might add – they needed to be recovered to their 'approved' pre-war state. However, it was not long before the Jaguar was committed to Operation WARDEN – the northern No-Fly Zone, which involved a further deployment, this time to Incirlik in Turkey.

The Jaguar continued to give valuable service and most of the improvements for GRANBY were subsequently incorporated as permanent fixtures across the fleet. There was even a belated engine upgrade and Jaguar provided the essential cover until Typhoon was assured.

In 2007, and with unseemly haste, the final aircraft were withdrawn. This was more than a dozen years beyond the 'out of service date' that I had been working to in 1990.

Looking back, the upgrade programme had truly been a case of New Jets For Old.

MORNING DISCUSSION

Mike Meech. Some reference has been made to communications. The systems available in 1991 clearly lacked the capacity and the sophistication of those that we have today. How capable were they? Were they, for instance, able to handle the quantities of raw data that needed to be transferred?

Air Chf Mshl Sir Michael Alcock. With great difficulty is the short answer. Although we didn't devote a specific slot to communications in today's programme, while preparing for the event I consulted AVM John Main, an acknowledged expert on what was happening at the time. He made the point, for instance, that every part of the communications system that we eventually used had been created in-house by the RAF Signals Engineering Establishment (RAFSEE), much of it produced by the Radio Engineering Unit (REU) at Henlow. This had involved, for instance, producing, in short order, 2,000 secret telephone systems designed by one of our group captain engineer officers. This was initially considered to be impossible! – but they did it.

Everything depended on Skynet, of course. We still had five satellites working at the time, although one was a bit dodgy if I recall correctly. The links were very low data rate at the beginning – perhaps 46Kbit/s? – but it was upgraded to about 80Kbit/s. Even that was ridiculously slow in today's terms, of course, but you have to bear in mind that the traffic we were sending at the time didn't require really high data rates. We weren't, for instance, transmitting photographs in 1991. The only way to send photography was by facsimile, which meant that the intelligence community wanted *secure* fax. We had never had secure fax before, but we did have some folk who knew how to do it in a small cell within the RAF's Special Signals Unit at Woolwich. They created a brand new system that could cope with secure high-quality fax. It was nothing like what we have today, of course, but it was all that we had – and it was very low data rate.

Engineering all of these arrangements to produce actual telephones on desks – and we have heard from Ian how they kept moving desks all the time – was something of a nightmare. Not least because there was a lot of local bureaucracy to overcome. That was eventually resolved after I had appealed to the Chief Executive of BT who

intervened personally. That resulted in Cable and Wireless, which was a part of the BT operation at the time, getting involved and making whatever deals were necessary with local telecom operators to make it all happen. It worked – in the end, but it was a nightmare – and our national facilities never had anything like the independence, resilience or security of those available to the USAF.[1]

Stephen Mason. Mention was made of 'cultural issues'. Could someone expand on that a little?

Air Chf Mshl Sir Patrick Hine. For the Saudis, the main cultural issues stemmed from their never having had foreign forces stationed on their soil throughout their 90-year history. At the working level, they had considerable difficulty in accepting female members of the coalition's armed forces, which was a particular problem for the Americans as something like 8% of their personnel were women. Some of them were drivers and, in Kingdom, Saudi women were not permitted to drive. When some of the more enterprising local ladies saw servicewomen driving, they took the law into their own hands and started to drive themselves. The Saudi authorities clamped down on them quite severely; for example, passports were confiscated and in some cases the offenders were virtually ostracised by their own families. So, that was a significant cultural issue in a social context.

In operational terms, when it came to mounting the invasion it soon became clear that none of the Arab contingents, notably those of Egypt and Syria, would set one foot inside Iraq. They were content to assist in the liberation of Kuwait because the occupation of a brother Arab state had been an affront to their culture, but they were not prepared to do themselves what virtually amounted to the same thing by crossing into Iraqi territory.

So those are two cultural issues that immediately spring to mind. It was a very disparate coalition – some thirty-two members – but it worked well. However, I have no doubt that had we pressed on beyond the relief of Kuwait, all the Arab members would have promptly withdrawn from the coalition, which would have created some real problems in political terms.

Air Mshl Ian Macfadyen. I would add a couple of points. In deference to the Saudi authorities, there was a total ban on alcohol, for

all contingents, throughout the deployment. We did have one unfortunate incident, involving the Hungarian NBC Group who decided to go on a binge one night – with neat alcohol! That created some embarrassment for us, as the UK was looking after them 'in loco parentis'. But a drink ban was strictly enforced so far as our own troops were concerned. It was quite for good one really – as a matter of fact I lost about 12 lb through laying off alcohol for eight months! (*Laughter*)

The other thing I would mention is religion. Getting padres into Kingdom was an issue in itself, and mounting church services was even more of a problem. We did manage to hold services but very much behind closed doors and within our own cantonments. You may recall seeing something of our Christmas service that was broadcast live on TV – but that was from Bahrain, not Saudi Arabia.

Gp Capt Jock Heron. In 1961, thirty years before GRANBY, there were indications that Iraq was planning to invade Kuwait and we deployed sufficient land, naval and air forces, including Hunters, to pre-empt this. Although monitoring, surveillance and intelligence facilities were far better in 1990, no steps appear to have been taken to reinforce the theatre to provide some form of deterrent. Could you comment on that?

Hine. I think that Saddam was lulled into what turned out to be a false sense of security by the American Ambassador in Baghdad's assurance that the US had no firm views on the relative merits of the border dispute between Iraq and Kuwait. This involved both the Rumaila oil field and the title to two small Kuwaiti islands, but it was anticipated that these matters would be resolved within the Arab League and without the use of force. Iraq's differences with Kuwait were of long standing, as in 1961 for instance, but there was no expectation within the Arab world that Saddam would resort to military action. He was seen to be moving troops to the border but that was perceived to be part of a process of intimidation, and so far as I am aware there was no hard intelligence, certainly not in my HQ, that an invasion was imminent. So, my recollection is that there was no reason to believe that Saddam was actually contemplating any use of force until the very last moment – no more than two or three days before he invaded.

Philip Styles. Some fifteen years before GRANBY I was with Plessey, working on radar absorbent materials. In our plant at Towcester we had a complete Tornado intake installation – an installation that had actually been specifically designed to minimise radar reflections. So I was intrigued to learn that the RAF had decided to try lining the intakes, because, as Wg Cdr Cummings said, radar absorbent materials are massively heavy – they have to be in order to absorb the energy. I was amazed to learn that we actually considered putting this stuff *inside* the intakes.

Alcock. It was pretty amazing to me too! (*Laughter*) Indeed, with hindsight, we can see that it was a particularly badly thought out process. When they started on the Tornado, they didn't really know how they were actually going to glue it – how they were going to cure it. We learned as we went along – hence the idea of inflating a plastic bag within the intake duct in an attempt to get the tiles to adhere to the walls. But, as anyone who has been in the engineering game for any time will know, the process of bonding dissimilar materials may look simple – but it just ain't – and what happens if the thing comes off?! Rolls-Royce were horrified when they found out what we were up to. This was all twenty years ago, of course, and I am speaking from memory, but my impression is that, while this was a well-intentioned project, it sprang from local enthusiasm and initiative, rather than a sound technical basis. I certainly recall finding, during my several visits to Leeming, that some folk were far less enthusiastic than others. The engineers were pretty committed to the idea but I spoke to a couple of navigators who were of the opinion that adding RAM would simply make their aeroplanes flare up on radar 'like Christmas trees'.

Ian Black. A couple of points if I may. First – radar absorbent material. I flew the Tornado F3 and it was a complete red herring. The idea is that putting absorbent material on the wings or in an intakes (to reduce the radar return from the disc of the engine's compressor blades) will stop your aeroplane showing up on an opposing fighter's radar. In practice, one might expect to pick up a fighter at a range of 45 miles or so and, with or without RAM, it made no difference at all. Furthermore, a loaded Tornado F3 was festooned with missiles – Skyflash – bristling with angular fins sticking out all over the place

and, unless you treated those as well, which was simply not practical, it just wasn't going to work. So – a red herring.

The other point I would make falls into the 'cultural' category. There was, I think, a missed opportunity. The RAF's F3s were based alongside No 29 Sqn RSAF which also flew the Tornado ADV but we never inter-operated with them. We shared a crew room but never integrated over engineering or operating procedures. We flew our CAPs and they flew theirs, but we never compared notes. Since we were a coalition force I think we ought to have mounted combined CAPs, two of theirs and two of ours. Does anyone know why we didn't?

Macfadyen. While I was still in theatre, post-GRANBY, we did start to work more closely with the RSAF but at the time there was, I think, to a degree, a lack of confidence among some of the RSAF aircrew. The more experienced pilots were very competent, of course, but the junior ones were, perhaps, less able to cope with all the things that were suddenly being thrown at them. I think that the Saudis recognised this after the war and did begin to do something about it. Subsequently, they have been far more integrated into the sort of operations that have been mounted in the region in the twenty years since GRANBY. In 1990 the Royal Saudi Air Force (RSAF) was still a young air force that has now gained much more confidence. There may still be some limitations but the RSAF participated in a RED FLAG last year and that in itself is a seal of approval. But, with hindsight, yes, perhaps we did miss a trick in not co-operating more closely.

Hine. My recollection is that the initial policy was for the USAF and RAF to mount the air defence CAPs to counter any possible incursion by Saddam's air force. I can't recall now when the RSAF's Tornado ADVs were first used on CAPs, but I believe it was exclusively USAF and RAF to begin with, and the Saudis joined in some time later. (*Confirmed from the floor by Ian Black.)*

Air Chf Mshl Sir Richard Johns. There was another issue that complicated the situation – Rules of Engagement – ROE. For several weeks we in the JHQ were involved in lengthy discussions over ROE and at one stage it looked as if the RAF might actually be taken off

task. It transpired that the Americans were operating to full wartime ROE whereas, at the time, ours were restricted to the defence of Saudi airspace and this had led to some practical incompatibilities. Does that sound right?

Hine. Yes, it does. It was just an unfortunate misunderstanding really. London and Washington had compared notes and endorsed each other's sets of ROE. Since everyone was content with the ROE, no one could see why there was a problem. What had happened was that, at General Horner's request, the Americans had moved the goalposts by implementing the war ROE and we had not been notified of this change. Once this mismatch had been identified we simply realigned our ROE with theirs and the problem was solved. But it was a significant problem at the time – it went on for more than a week.

Macfadyen. It is, I think, a matter of record that the wartime ROE for all British forces were only finally agreed a matter of hours before the start of hostilities. That was certainly a major issue for some people. I believe I am right in saying that some people – for example, the tanker force – didn't get the final ROE until after the war had started!

Hine. I have to say that the way in which national ROE were handled was a disgrace. The JHQ submitted draft war ROE to the MOD in mid-December. At that stage, I knew that the air campaign was scheduled to begin on 17 January, so we needed to have the rules cut and dried well in advance of that date. There was also some concern that Saddam might take advantage of the Christmas period to mount some sort of pre-emptive action, so we drafted a second set of ROE to cover that specific contingency. To the best of my knowledge, we never did receive clearance for the pre-emptive ROE, and it was very late on, 2 or 3 days at the most, before the war ROE were approved.

Shortly before Christmas, a Defence Minister visited the Gulf and, while on board one of the Royal Navy's Type 42 destroyers, was told that Saddam was capable of attacking our ships there and thus it was essential for the crews to have approved ROE. The response was along the lines of 'ROE, that is a very esoteric subject best left to the experts, I will raise the matter when I get home'. He showed no understanding of the urgency at all. You can imagine how this went down with the ship's company. Peter de la Billière was present when

this exchange took place and reported on it to me that evening. It was disgraceful.

Macfadyen. We banged on about ROE when that same gentleman visited Riyadh – but he showed little interest.

Wg Cdr Jeff Jefford. Sir Richard, you spoke about the need for stamina. Was there any use of prescription 'uppers' and/or 'downers' at the HQ – or in the field?

Johns. Alan Johnson, who was PMO at the time and is in the audience today, and I had lengthy discussions over this and I think that it was during GRANBY that we agreed that, because it is non-addictive, transport crews, particularly the Hercules crews, would be allowed to use Temazepam. I certainly used it – on the PMO's prescription, of course – because I was leaving the bunker at about 2pm and going back at 10pm – and with all the normal family routine going on in the background, one simply needed to get some rest. I found that Temazepam did exactly that.

AVM Alan Johnson. We had done extensive trials at Farnborough on Temazepam as a short-action hypnotic to ensure a period of sleep and, most importantly, no deterioration in performance on waking up – no hangover effect. On that basis I had a very large jar of Temazepam which we took around the HQ, quite informally, because it was important that people should have good quality sleep when their circadian rhythms were being disturbed by the imposition of, often irregular, patterns of shift-working. We didn't use 'uppers' – coffee is still the best upper.

Hine. I think that we had previously used Temazepam on a trial basis during lengthy TACEVALs when crews might find it difficult to get much rest. That had been very successful. The advantage of Temazepam was that it permitted you to snatch 2-3 hours of sleep by stopping the mind from 'spinning', but that if you then had to be woken suddenly as the war restarted, you were immediately alert. There were no after affects, as there are with Mogadon for instance. Temazepam was developed by the Institute of Aviation Medicine for military purposes and was first used in earnest, I believe, during the Falklands War.

Peter Crispin. Just a comment on the lack of warning of Saddam's invasion. My brother, who had been in Kuwait as a subaltern with the artillery during the 1961 incident, happened to be there again in the summer of 1990. The day before his wife and family were to join him, they rang the Foreign Office who assured them that there was 'no threat to Kuwait'. So they flew out. Three days later Saddam invaded. So, there you have the official party line, and I think that says it all.

Hine. Yes, Saddam undoubtedly achieved strategic surprise, and he chose the right time of year. Many people in the NATO nations, including ourselves and the Americans, were on summer holiday. He certainly fooled me, as I started leave on that very day! (*Laughter*).

Air Cdre Jim Uprichard. I was working on the Commitments staff at the time of this operation and, if you recall, two or three days before Iraq invaded Kuwait we were handling a little insurrection in Trinidad and Tobago. I was a member of the briefing team for COBRA and one of the 'Duty Colonels'. As I went off duty at 10pm on 1 August, I was briefed by the Army Intelligence Officer, a major, who said that there was no possibility of Iraq invading Kuwait. They were putting pressure on the Kuwaiti Government, but there would be no invasion. I went home and at 6 o'clock the next morning I got a telephone call to tell me that Iraq was in Kuwait city. So – for the record – that was the information available in Commitments.

I would like to make a second point, which is to reinforce what Sir Richard said about the working relationships in London. Across the corridor in the Ministry, the Commitments staff and the Secretariat were at war – especially over ROE. And that for me, was the most regrettable aspect of working on the staff at that time.

Hine. It reached a ridiculous but serious level. We were having to argue the case back and forth with MOD over something as marginal as the need to deploy another 20-30 men. Rather than helping to provide the manpower resources required to fight a rapidly approaching war, the Defence Secretariat carried its scrutiny role to excess, prompted needless to say by the Treasury. As a result, they would go through every submission with a fine toothed comb. It was all taking far too long, sometimes involving a submission shuttling to and fro three or four times – all very frustrating. In the end, with about

two weeks to go, I intervened personally with the Secretary of State, and after some discussion he agreed that I could authorise the immediate movement of up to a total of 250 more men, leaving the paperwork to catch up later.

Johns. I'm not in the business of defending the Ministry of Defence, but when it was decided to deploy 7 Armoured Brigade, their planners came to the JHQ with their staff tables and so on and they were talking about sending some 7,500 men. We did the necessary work in the BMG and submitted the bid to London. But within a week or so the bid had grown to about 10,000. That, inevitably, provoked some suspicions about our manpower calculations and from then on we were always fighting an uphill battle – especially over manpower which became the Ministry's primary focus when it came to imposing resource constraints. That did have the advantage – Mike you might have a view on this – that it took their eye of the amount of money that we were spending on modifying our aircraft to get them fit to go to war.

Alcock. Yes, absolutely. There was never any reluctance to spend money. There were constraints on the numbers of aircraft that we were permitted to modify but I never encountered any problems getting people to authorise more upgrades. That said, I was a bit concerned that we might have been wasting money on some things – we have talked about radar absorbent material – but it is very difficult to apply the brakes to a project when time is short and it has been based on an apparently sound operational requirement. That particular issue was a real worry to us on the engine front because, dare I say it with a Rolls-Royce representative in the audience, the RB199 wasn't the most reliable engine that we had ever built, especially after we upgraded its performance for the F3. And then we wanted to increase its dry thrust for use in-theatre – and do the same for the Adour so, while there was all kinds of expenditure on engines that really needed to be done, I wasn't quite so confident that some of the other modification that we did were all that clever. Nevertheless, there was ample authority for spending money. I hadn't thought about it before but if that was because the JHQ was having trouble with its head count – thank you! (*Laughter*)

Note:

[1] In the aftermath of the seminar Air Chf Mshl Alcock consulted AVM Main again to confirm his recollections of some of the communications issues associated with Op GRANBY. AVM Main (an air commodore in 1991) provided a number of random observations that served to amplify what Sir Michael had said at the time and are worth reproducing here, for the record.

> The CIS (Communications and Information Systems) activities for the first Gulf War were masterminded by the MOD CIS Committee which was chaired, either by RAdm Rob Walmsley, ACDS(CIS), or by myself, as DCIS (Pol&OR). The single Services and the Operational Commands were all represented on this Committee. We held forty-four meetings, all of which were documented and the minutes must reside somewhere in the MOD archives. A document was subsequently produced enumerating the lessons learnt. Sad to say that, like the Falklands' 'lessons learnt', they too were soon forgotten, or changed due to financial pressures.
>
> The RAF was represented by Air Cdre Dick Elwig (HQSTC), supported by Major Hood and DSigs(Air), Air Cdre Richard Fitzgerald-Lombard, or his deputy, Gp Capt Dick Whittingham.
>
> RAFSEE (Support Command) was tasked by DSigs(Air) to meet Urgent Operational Requirements through the standard Electrical Engineering Instruction route. The Radio Engineering Unit (RAFSEE) carried out many of our manufacturing tasks and most of the installation work. The Special Signals Unit (Support Command) concentrated on the provision of cryptos and the TEMPEST testing (*Ensuring that a device does not emit radiation or generate detectable stray voltages that could compromise the security of the information being transmitted*. **Ed**) of new equipment procured for the operation. The earth stations at Oakhanger and Colerne operated by No 1001 Signals Unit (Support Command) were an essential component of our communications network and the provision of IT to the battlefield. The earth station at Defford (Defence Research Agency) was also used to supplement No 1001 SU's. resources.
>
> Intelligence circuits were engineered by both RAFSEE and GCHQ.
>
> BT and Mercury provided additional megastream capability and BT re-engineered much of the connectivity to No 1001 SU. BT International were instrumental in unlocking access to the Saudi PTT connectivity; access to other countries' PTTs proved less troublesome. (*PTT – Push-to-Talk – is a technique that, in effect, permits a mobile phone to function as a 'walkie-talkie' with unlimited range, allowing the user to address a number of subscribers simultaneously.* **Ed**)
>
> No 1001 SU's technicians were seconded to the US-provided Satcom terminals that provided the Ptarmigan bridges. (*Ptarmigan is a mobile, cryptographic, digital battlefield communications system originally designed to meet the needs of BAOR*. **Ed**).

The Electronic Warfare and Avionics Unit (Support Command/RAFSEE) provided ongoing support to No 51 Sqn and developed SRIMs (Service Radio Installation Modifications) as required.

The Tactical Communications Wing deployed in-theatre was a Strike Command Unit.

OPERATION GRANBY – AIR TRANSPORT OPERATIONS

Gp Capt J A King

Jerry King joined the RAF in 1962. After an initial tour on the Argosy in FEAF, he spent much of the next 20 years associated with the Hercules, including tours with No 36 Sqn, JATE, on exchange with the USAF, and as a Flight Commander with, and later OC of, No 47 Sqn. This was interspersed with staff appointments with the SAS and at Upavon and High Wycombe (as Gp Capt AT/AAR during the 1991 Gulf War) before conversion to helicopters and command of RAF Benson. His final tour was as Command Intelligence Officer at HQ STC.

Like so many other Operation GRANBY records, the air transport (AT) story is one of maximum effort over many months. My report today is largely chronological, although most aspects were relevant from the first frantic deployment to the eventual completion of recovery. First in, last out – as usual.

I will consider the topic in five phases: the initial surge in August; the build-up of forces until November; resupply and reinforcement into January and February; operations during hostilities; and finally recovery and redeployment.

My report will take most of its examples of lessons learnt from the first phase – the initial surge. Although most could just as well be drawn from the other phases. I will avoid quoting too many statistics, although any full history of the AT Force (ATF) effort would be littered with them.[1] I will not include the support of Special Forces, although that task was essential and a source of pride, and I will not include tanker operations, although a significant element of the airlift was achieved by dual role tanker-transports with fast jets alongside. However, I will include civil aircraft charter and burden sharing – essential parts of the airlift picture.

1. Initial Surge

Command and Control

At MOD the Defence Operational Movements Staff (DOMS) provided overall guidance on requirements and the use of aircraft,

A Hercules being unloaded in-theatre. (R Mighall)

switching resources as required, providing the political link in MOD, and having special responsibility for augmentation by charter. Importantly, from an early stage it made block allocations of aircraft to the Joint HQ for us to decide their detailed use.

Management of air deployments and the tasking of airlift and allocation of loads were done in the JHQ by the Airlift Control Centre (ALCC), with perhaps thirty people at any one time responsible for all aspects of the allocation of AT aircraft and personnel to task. In normal times this staff had similar responsibilities above ground, so had a relatively straightforward transition to 24-hour working underground. In time, the ALCC included additional desks for diplomatic clearance, aeromedical, army logistic inputs and eventually a passenger cell. There was, of course, constant discussion with Logistics Control.

The ALCC proved effective and responsive, not least because it included experienced aviators who understood the challenges faced by the crews and because next door was the ATF Operations Centre (the ATFOC), a small cell of about six personnel that was already permanently underground, 24 hours a day, controlling AT aircraft on route.

Route Activation

An MOD flash signal at midnight on 8 August formally initiated activation of the main routes via Akrotiri; final destinations were to be decided. The Force was to plan on 170 Hercules and forty VC10 sorties over ten days; Lyneham's commitment was to use twenty-seven Hercules and fifty-seven crews[2]. This commitment effectively

halted aircrew training.

Thanks to some pre-warning, route activation personnel and equipment were airborne within hours; these included aircrews and specialists in mobile air movements, ground engineering, supply and flight watch communications – with sleeping bags, NBC kit and, for the aircrew, AR5 suits. Equipment included some vehicles and freight handling equipment. With these steps taken the ATF was ready for tasking into the Gulf.

Akrotiri

From our viewpoint, the obvious attractions of having Akrotiri as the hub were permanent staff familiar with AT ops, a passenger terminal and an ASMA-equipped Operations Centre. The build-up was impressive: after only six days, of the ninety-eight AT crews involved in GRANBY, forty were at Akrotiri. Eventually Akrotiri was to handle almost 14,000 GRANBY movements, of which nearly 8,000 were dedicated to freight.[3] Over the coming months, despite sterling work by the hosts, accommodation limitations would be a recurring challenge. Crews – and other transit personnel – slept where space could be found, such as mattresses in the Officers Mess Ladies Room. Some permanent staff gave up their own rooms, and 800 bunk beds were added in November. The *ad hoc* arrangements were, to some extent, responsible in due course for aircrew fatigue problems.

Onward Deployments

The Jaguar deployment to Thumrait provides illustrations of some elements to be considered when we mounted AT tasks. Ideally an AT detachment will already be in position at the destination airfield ready to receive, unload and refuel the aircraft, accommodate the crews and so on. In Op GRANBY, timescales sometimes meant the AT detachment arrived on the same flight as the Squadron Commander and his advance party and kit. So it was for the Jaguar deployment to Thumrait on 12 August. Things became even more interesting when, with a VC10 and eight Hercules en route behind them at half-hour intervals, they found the base already occupied by the USAF – including a wing of thirty C-130s. The remainder of the Thumrait lift was completed after four days using a further forty-seven sorties. As became the norm in such Gulf moves, a major part of the lift – nineteen of the twenty-two VC10 sorties – was dedicated to carrying

weapons.

Meanwhile the Tornado F3s were deploying to Dhahran from Akrotiri using twenty-six AT sorties, including six mounted earlier from Leeming and Coningsby. The three Nimrods arrived at Seeb on 13 Aug and were self-supporting for five days till AT lift became available. Finally, an HS125 from the UK took a team to survey Riyadh, Dhahran and Tabuk.

Operational Constraints

To achieve the maximum outload in the minimum number of lifts, various aircraft and crew limitations were relaxed. Military operating standards (eg maximum allowed aircraft weights) were authorised from the outset for many sorties. Distances into the Gulf meant that maximum crew day limits were extended from 16 to 19 hours, and on occasion they were extended further with ALCC authority. Minimum crew rest was reduced, and some other currency and training waivers were granted, without which the tasks could not have been achieved. All leave was cancelled.

An aspect that could make or break success was diplomatic and overflight clearances. Most en-route nations were fully cooperative, but there were still some challenges for the diplomatic staffs. European nations had agreed to give GRANBY flights priority, but for a while France's slot time system resulted in no priority. Later, by the end of September, Austria approved overflight, which saved considerable time, especially for the flights from Germany to the Mediterranean.

In the Middle East there were generally few clearance problems. Egypt was an exception, where national procedures required 72 hours agreement to callsign, entry and exit positions, times and so on. The situation eased after pressure by the Air Attaché, but every slot time still had to be tied to a pre-cleared callsign – a major constraint in such fluid tasking. The solution was called 'ghost clearances': as an aircraft reached Egyptian airspace, if necessary, it adopted the cleared (ghost) callsign, then on leaving reverted to its original callsign. Thereafter this unusual system generally ran smoothly.

Home Bases

At home, Lyneham and Brize Norton upped the tempo well. In six days, Lyneham had mounted fifty-four round trips to the Gulf and had

The TriStar, the RAF's biggest heavy lifter, could take nine 2½ ton JP233s at a time. (Mike Freer)

flown half a normal month's hours. Thereafter tasking settled at nearly twice the normal rate. The pressure on the Hercules crews mounted quickly, as they were established for fewer crews per aircraft than the Brize Norton AT crews. Continuous operations required reinforcements, especially in the ground trades. An example of an added commitment was the requirement to issue and train deploying passengers with arms and NBC kits, with consequent pressure on supply and RAF Regiment staff.

Follow-On Ops

The initial surge was in most respects complete by 15 August. There was little time for consolidation, as the fleet completed the deployment of Phantoms and Rapiers to Akrotiri and the seemingly unending lift of JP233. A daily scheduled Hercules resupply from UK to five of the Gulf airfields began. At the end of the month the Tornado GR1 deployment to Muharraq from Germany required fifty Hercules, eighteen VC10 and eight TriStar sorties. Frustratingly, the weapons storage capacity at Muharraq was less than anticipated, so some Hercules had return to Akrotiri without landing.

The airlift bill for weapons was demanding: a TriStar could carry nine JP233s and, depending on the mark, a Hercules could carry three or four – and little else. The choice of air versus sea was driven by the benefits of collection and drop-off from airfields close to storage facilities and the uncertainty over when hostilities might begin.

The USAF provided assistance with outsize loads, as in C-5s to move Pumas to the Gulf.

2. Build-Up Of Forces – September to December

September's airlift activity was at a relatively steady tempo, with two resupply Hercules daily, weapons outload continuing at a high rate, field hospital and RAF Regiment deployments and some roulement tasking. Mid-month brought news of the deployment of 7 Armoured Brigade, plus some additional Tornado F3s, and a Tornado GR1A squadron which was at Tabuk by 8 October.[4]

Deployment of 7 Armoured Brigade

Much of 7 Armoured Brigade's freight went by sea, but there was still a major air task. The advance party left Gütersloh on 28 September, and the main parties flew from Hamburg. The airhead was Al Jubail's 13,900ft runway, northwest of Dhahran; it was closest to the brigade's deployment area in the desert and to the sea port in order to marry up troops with their seaborne equipment.

The move took over a month and went well, although some later sorties were delayed a few days to match the arrival of troops with their sea-move equipment. This time the ATF was supplemented by a British Caledonian TriStar, and four USAF C-5s moved support helicopters.[5] Thereafter a regular resupply schedule to Al Jubail was

A Hercules on a natural surface landing strip.

established.

AT Detachment at Riyadh – Hub and Spoke

Elsewhere in the Gulf, the use of a daily resupply Hercules serving so many bases resulted in inefficiencies and frustration for receiving units. However TriStars could take a maximum load direct to Riyadh where there was still ample ramp space, and access to storage, handling equipment, accommodation, etc – although in due course all facilities became constrained by other arrivals. Therefore a 'hub and spoke' operation was established using an AT detachment at Riyadh to support the seven other airfields in theatre.

CBFME exercised Tactical Control of the Hercules, an HS125 and an Islander through his Joint Transport and Movements Staff (JTMS). JTMS would also be responsible for dispersal of freight arriving from the UK and obtaining any necessary extra airlift.

The Riyadh detachment's sixty-two personnel with three Hercules and six tactically qualified crews were ready for tasking on 2 November. In addition to airlift tasks, they refreshed skills in low flying, natural surface strip landing, airdrop (although this was not used in anger), and aeromedical evacuation.[6] They also developed

Not for the first time, the RAF was obliged to hire, what used to be its own, Belfasts from HeavyLift. (HeavyLift)

planning and flying procedures to accord with complex airspace control processes, not least because – unlike the Special Forces aircraft – they lacked inertial navigation systems or Mode 4 IFF. Later two RNZAF Hercules with three crews were absorbed into the detachment, and were followed by an additional four RAF Hercules and eight more crews.[7]

Sustainability

There was already discussion about the long-term implications for aircraft sustainability and personnel. Other military demands for airlift had continued, especially the Army's exercise and training programme, and all three services had other non-GRANBY commitments that required priority. Enhancement with civil charter or other forces was increasingly needed. This was not new; as early as mid-August HeavyLift's ex-RAF Belfasts had lifted fuel bowsers to Akrotiri. Some Western European Union (WEU) countries had offered military transports under burden sharing, and the two serviceable Kuwaiti C-130s were made available for in-theatre tasking.

November brought a slight lull, and the Hercules force managed some training. Daily tasking reduced to ten Hercules, one or two TriStars and a single VC10, plus weekly aeromed and passenger lifts. November also saw a number of sustainability factors gain prominence – aircraft servicing, a pause in OCU training, overstretched personnel, and a developing freight backlog.

The aircrew fatigue problem was greatest among the Hercules crews, with their low crew-to-aircraft ratios and other factors

A VC10 at Brize. (Mike Freer)

mentioned previously. Close supervision was needed, not least when tired crew members simply wanted to keep doing a job that they enjoyed. An Institute of Aviation Medicine study into their long-term fatigue resulted in a tightening of some crew duty limits. On the aircraft engineering front, similar reviews of aircraft fatigue life also resulted in capping of hours in order to preserve a surge capability.

The amount of air freight had exceeded all expectations, and there was a backlog of several days. In addition to the sheer volume, other factors included: the priority system which was not really suited to the GRANBY scene and had become misused; a serious shortage of cargo storage and handling facilities; late availability of items from industry; and difficulties in tracking critical items. The backlog continued to build during December and into January.

3. Resupply and Reinforcement – December to January

4 Armoured Brigade And Other Deployments

Late November brought the announcements of the moves of 4 Armoured Brigade and a Divisional HQ. The methods used for the deployment from Gütersloh and Hannover were much as for earlier well-proven moves, and by 11 January the ATF and two Boeing 747s had moved 16,500 troops and 171 vehicles into theatre.[8] Concurrently Rapier units had been moved to Tabuk, and RAF Regiment and additional Tornado resources to Muharraq. Thereafter the ALCC's

Portugual	C-130
Belgium	C-130 (inc daily schedule UK-Gulf from mid-Dec)
Spain	C-130 (aeromedical)
Germany	C-160 including Decimomannu schedule
Italy	C-130
Germany	Boeing 707 (aeromedical contingency provision)
Belgium	Boeing 727 (aeromedical contingency provision)
USAF	Including: C-5s (helicopters to Gulf) C-130s (Jaguar det Thumrait to Muharraq)

Fig 1. Military airlift assistance.

daily tasking for GRANBY was fifteen by Hercules, two by VC10 and three by TriStar – plus a Kuwaiti 747 and some additional airlift.

Charter & burden sharing

As mentioned previously, since early in the campaign some extra capacity had been provided by charter and other nations' aircraft. To some extent tasking had been as required, and there was now a need to move to longer-term arrangements. So civil airlines took over the Falklands airbridge and the North Atlantic schedule. Ultimately fourteen civil airlines provided aircraft at a total cost of £61M. Most were used for carrying freight. Additionally, the WEU and USAF provided assorted military airlift assistance by the end of GRANBY; this is summarised at Figure 1:

Of course all moves needed coordination through the various airfields. Some operators observed the ALCC scheduling, other were more 'relaxed', inevitably causing problems at the airheads.

4. AT Operations During Hostilities

At the start of the Air War, a hold was placed on all passenger and freight movements. Many aircraft were grounded where they were, including fourteen from the ATF and eleven on charter. Not surprisingly the freight backlog, which was already standing at four days, increased. When movement restarted, an all-out effort to clear the backlog began, using all AT resources, increased charter and allied help. The situation was not helped by the refusal of some charter crews to fly into Saudi airspace, even though the Government was accepting the insurance risk for civil aircraft in-theatre. Nevertheless,

A Hercules climbs out into the man-made instrument flying conditions created by Kuwait's burning oil wells.

and impressively, by the end of January the backlog was down to one day's load.

The AT Detachment at Riyadh was as busy as ever. It was already making use of natural surface strips such as Abu Hadriya, near Al Jubail, with a 4,000ft flinty runway; it was invaluable for the move of 7,000 troops of 4 Armoured Brigade inland to Qaysumah over ten days in early January. Passenger uplift in the Hercules was maximised by combat loading – no seats, just straps across the floor for seated troops to grip, and a clear aircraft floor for return flights. Other airstrips were prepared further west and became the scene of hectic activity moving-in last minute supplies for the land campaign.[9]

Considerable work had gone into the aeromedical evacuation plan, honing the expertise of medical teams and crews, anticipating in war a total of fourteen aeromedical tasks a day from the forward airstrips back to Riyadh or Al Jubail, and then by strategic lift to Akrotiri or the UK. An indication of the importance placed on the aeromedical plan was that on 25 February there were seventeen British civil and WEU aircraft on aeromedical standby outside the Gulf.

As the ground war developed, in-theatre tasking continued apace. As was soon apparent, the aeromed task was modest, but there was some surprise at our having to move 7,000 POWs instead. Thereafter three Hercules from the Riyadh Detachment were the first fixed wing aircraft into the oil-blackened and sabotaged Kuwait Airport.

'First in; last out'. With the fighting over, the ATF's task simply switched from deployment to recovery.

5. Recovery and Redeployment

Kuwait Airport was of little use to the detachment, so the Hercules operated forward to landing zones adjacent to the brigades astride the Kuwait/Basra Road. From there they conducted the main recovery of Army personnel to the airheads for processing and flights back to the UK or Germany. The achievements of the Detachment were impressive: by 4 March it had flown 2,365 sorties, 3,152 hours, 20·34 million lbs freight and 23,270 passengers.[10] Thereafter there was a gradual reduction in the detachment until, by 14 April, it was down to one Hercules. The HS125 came home in early April.

Although the war was over, AT flying hours in March matched or exceeded the busiest of the previous summer and of the January catch-up deployments. By the end of the Operation, the transport fleet had logged over 50,000 flying hours, having flown at more than twice their normal peacetime rate. The aircraft had carried 30,000 tonnes of freight and 66,000 passengers, consuming 54 million gallons of fuel on over 12,500 sorties.[11]

The AT air and ground crews returned home to R&R, to restoring lost skills and to aircraft maintenance. The Akrotiri detachment was due to withdraw at the end March; but not all of the personnel got

home then, because the AT force, like the helicopters, departed for a new commitment at Incirlik to provide airdrop relief to Kurdish refugees. That operation was, in turn, to become yet another airlift success story.

Notes:

[1] With the exception of other endnotes and some identifiable personal views of the speaker, this brief is based on the draft report by the RAF Air Historical Branch *Operation GRANBY – Air Transport Operations.*

[2] Timeline of Operation GRANBY at:
http://www.raf.mod.uk/history/TimelineofOperationGRANBY.cfm

[3] Despatch by Joint Commander – Supplement to *The London Gazette* of 28 June 1991 – page G40.

[4] *Ibid.*

[5] Movements Control Association report on the movement to the Gulf of BAOR troops and equipment at http://www.movcon.org.uk/History/Documents/ Reference 270.1.

[6] *C-130 Operations in the Gulf War* – presentation about the Riyadh Detachment to Gulf War Symposium, RAF Cranwell, May 1991.

[7] Despatch by Joint Commander *op cit* – page G40.

[8] Movements Control Association report on the movement to the Gulf of BAOR troops and equipment at http://www.movcon.org.uk/History/Documents/ Reference 270.1.

[9] *C-130 Operations in the Gulf War, op cit.*

[10] Riyadh AT Detachment stats board – image in *Support Save Supply* by Rob Bailey, published by Airlife Publishing Ltd, 1992.

[11] Despatch by Joint Commander *op cit* – page G42.

THE AIR CAMPAIGN PLAN AND AIR TASKING ORDERS

Air Chf Mshl Sir William Wratten

A fighter pilot by trade, Sir William Wratten has flown more than twenty types of high performance aircraft and displayed Hurricanes and Spitfires with the BBMF. During his forty years of service he commanded at all levels, notably in 1982 when, in the Falklands, he was responsible for establishing the post-hostilities air defence system for the islands, and in 1990-91, when he commanded the RAF contingent involved in the Gulf War. His final appointment, as AOCinC Strike Command, made him a full member of the Air Force Board.

The aims of the DESERT STORM air campaign were:

- to gain and maintain air supremacy;
- to neutralise the C^2I targets. In effect, to cut off Saddam's head, to prevent him from talking to his people;
- to seek out and destroy all NBC facilities – with particular regard to weapon-to-target matching as far as the biological agents were concerned;
- to interdict the Iraqi lines of supply – in particular oil, but without destroying the installations;
- to seek out and destroy the Republican Guard and
- to reduce the Iraqi Army in the desert to 50% of its capability.

The last of those was more easily said than done, as it proved to be very difficult to make such an evaluation, not least because the methods used by the Intelligence community in making their Battle Damage Assessments (BDA) produced results that often differed from the perceptions of the operators in-theatre who were seeing their Maverick missiles taking out tanks one-by-one with unerring accuracy.

The man responsible for planning and conducting the air campaign was COMCENTAF, Lt Gen Chuck Horner. Having flown as an F-4 pilot during the Vietnam War he was subsequently heavily involved in the development of the Flag training programme. Totally committed

COMCENTAF
Lt Gen Chuck Horner

to ensuring that his air campaign would be implemented efficiently, he nevertheless imposed several constraints. In particular, he sought to minimise loss of life, especially among the Coalition forces – and civilians – and to avoid damage to holy shrines.

So far as the RAF was concerned, the fixed wing aircraft committed while the air campaign was actually being conducted are listed at Figure 1 (for the locations of the airfields see Annex A). There were significant differences in the facilities available at these bases. Tabuk, in the west was, while not exactly 'bare base', certainly lacking in frills. At the other extreme, at Bahrain, the crews were living in 5-star hotels – with access to alcohol. But even at Tabuk our people were a lot more comfortable than Patrick Cordingley's Desert Rats who were living under their tanks in the desert.

This was a major undertaking for us, of course, but it was dwarfed by the size of the air forces deployed by the coalition as a whole, especially by the United States, all of which were available to Horner.

Base	Detachment Commander	Aircraft
Tabuk	Gp Capt R W H Hedges	15 × Tornado GR1 4 × Tornado GR1A
King Khalid International*	Gp Capt G D Simpson	9 × VC10K 1 × TriStar 7 × C-130 2 × C-130 (RNZAF)
Dhahran	Gp Capt D R Spink	18 × Tornado F3 12 × Tornado GR1 6 × Tornado GR1A
Muharraq (Bahrain)	Gp Capt D F A Henderson	13 × Tornado GR1 12 × Jaguar 7 × Victor 12 × Buccaneer
Seeb	Wg Cdr A B Wight-Boycott	4 × Nimrod

* Plus an HS125 operating from nearby Riyadh.

Fig 1. RAF fixed wing deployments during the combat phase of Op GRANBY.

The Air Order of Battle is outlined at Annex B but, from the USAF commitment, I would highlight, first, the B-52s, of which he had more than sixty, flying out of Fairford in the UK, Morón in Spain, Jeddah in Saudi Arabia and Diego Garcia in the Indian Ocean. Secondly, there were the U-2s and TR-1s at Taif and finally, the forty-two F-117s operating from Khamis Mushait. Being based down in the extreme south west meant something like a five-to-six hour round trip for an F-117 attacking a target to the north of Baghdad.

Aside from the air forces, Horner also directed the efforts of no fewer than six Carrier Air Wings. This was, I believe, the first time that the US Navy had ever had six of its Carrier Battle Groups in the same theatre – three in the Red Sea and three in the Persian Gulf. Between them they could field almost 400 F-14s, F/A-18s and A-6s of various models. I should make the point that the RAF's tankers were frequently tasked to support these US Navy aircraft, as they use our probe and drogue technique, as opposed to the USAF's flying boom. In addition to these naval aircraft, Horner could also direct the employment of the remarkable cruise missiles that could be launched from both surface vessels and submarines.

I would also mention the US Marine Corps, who were the only users of the Harrier – about sixty of those, along with yet more A-6s and scores of F/A-18s.

Rounding it all off were the Saudis themselves, with substantial numbers of F-5s, F-15s and Tornados, along with the air contingents contributed by France, Canada, Italy, the Gulf States and the refugee aeroplanes from Kuwait.

Chuck Horner's task was to take the enormous array of air power at his disposal, amounting to a little short of 2,000 armed aircraft, and organise, harmonise, co-ordinate and control their operations in order to achieve the aims of the air campaign. Since he had so many assets available to him, rather than attending to each of these issues in turn, he was able to address them all simultaneously. The mechanism that he used in order to implement his plan was the Air Tasking Order (ATO), which was published daily, in advance, to cover the air operations to be conducted over the next 24-hour period.

The drafting of each ATO followed a set procedure. The first stage was represented by the two 'O Groups' convened, and presided over, by General Horner each day – one early in the morning, the other

The 'top table' at the O Group, chaired by Lt Gen Horner, on the right, with AVM Wratten, representing the British air contingent facing the camera, second from the left (with rolled sleeves) and his French counterpart to his right.

fairly late at night. These were attended by about one hundred delegates, representing the various aircraft types and the many detachments, with whom they had direct communications. They were there to listen to, rather than participate in, the O Group. The participants were about a dozen key officers sat around a 'top table' – the Air Commanders of the national air contingents and Chuck Horner's Heads of Department – his chief logistician, his chief engineer, chief supply officer, head of intelligence and so on.

The agenda was as one would expect. There would be the usual briefings on weather and intelligence; a summary of what had been achieved in the previous twelve hours, and a reminder of what was planned for the current twelve hours; any losses and/or ongoing combat survival and rescue operations were noted; and there was an opportunity for the national representatives to raise any issues of

particular concern to them. Horner would then summarise – very expertly I may say – his impression of how things were going and impose any planning constraints or provide any specific direction that he considered appropriate. He might, for instance, indicate where effort should be concentrated, which weapons should be conserved, and so on. When he had finished speaking, everybody in the room had a clear idea of the current situation and knew what was going to happen over the next 12 hours.

While this had been going there would have been an officer standing behind Horner's chair, taking it all in and making notes. He would have been one of three men – Maj Gen John Corder, Brig Gen Buster Glosson or Lt Col David Deptula. Those were the three men who between them supervised the Planning Cell – what the Americans called 'The Black Hole'. In this Planning Cell, which was a fairly large room, were banks of computers, programmed with state of the art planning software and tended by IT 'whizz kids', who were overseen by the planners, all of whom were experienced front-line operators. We had our own RAF representatives within this Planning Cell under Wg Cdr Mike Richardson, an ex-Tornado man.

Following the O Group whichever of the three supervisors was on shift would go straight into the Planning Cell and update the team on what was required, so there was an immediate, and virtually seamless link between the Air Commander's assessment and those who were to translate his latest guidance into an operational directive in the shape of the next ATO. Although an ATO was issued on a daily basis, the drafting of each one was a rolling process that took about 72 hours to complete, so there were always three in work, with changes being introduced in the light of the feedback from each O Group. About 20% of the targets identified in the initial draft of an ATO would have been changed by the time that it was actually released. When the land offensive began the situation became increasingly fluid and the incidence of targets being changed rose to more like 40%.

The drafting process followed the sequence, represented by Figure 2. The first two stages, which set the scene, were, in effect, the feedback from the O Group. The next box dealt with the Airborne Elements of the Theater Air Control System (AETAC) – in other words AWACS – the E-3 Sentries and the US Navy's E-2 Hawkeyes. Units would be assigned Mission Numbers, orbit locations, times on

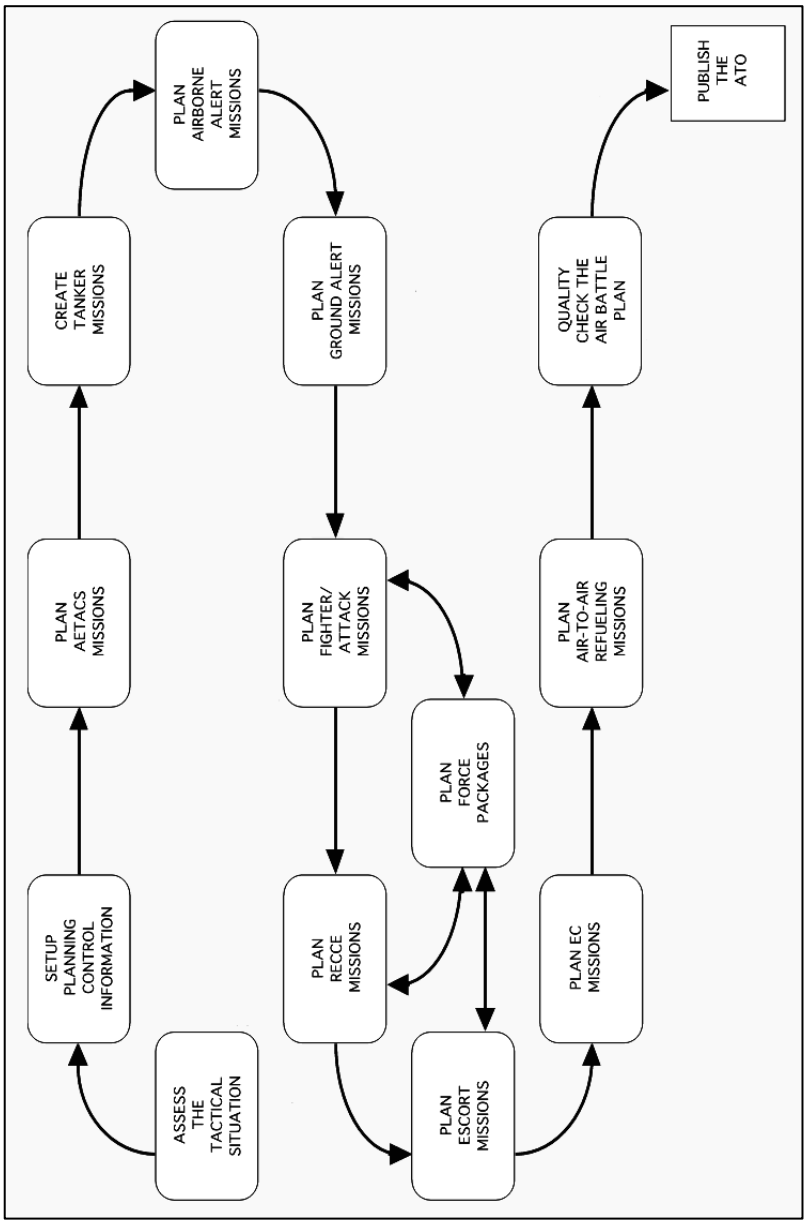


Fig 2. The planning sequence that governed the drafting of an ATO.

and off station and so on. The next stages did much the same for tankers, airborne alert missions – which were close air support (CAS) aircraft available on what amounted to a 'cab rank' basis – and ground alert missions – more CAS aircraft held in reserve but available at short notice. Between each phase, the developing plan would be reviewed to permit earlier stages to be amended.

The next stage, the planning of the Force Packages, was more complicated, of course, as it became a closed loop with the demands of weapon-to-target matching driving the numbers of strike aircraft, along with the associated provision of fighter escort and suppression of enemy air defences (SEAD) and, finally, post-strike recce all interacting with each other. When the process was complete, each package would be reviewed and its needs reflected in further amendment to the tanker requirement.

Apart from post-strike recce, there would be other dedicated reconnaissance tasks such as *Scud*-hunting, persistent surveillance by drones and coverage of specific targets by U-2s. The next stage covered Electronic Combat (EC) Missions, ie SIGINT/ELINT, and again units would be assigned Mission Numbers, orbit locations and so on. With all of that complete, it became possible to refine the refuelling plan to match tankers with receivers at specific times. The whole plan was then checked, cross-referred, checked again and then published, ideally electronically but failing that, by whatever means was available.

A sample page from the first (of a two-part) ATO is at Figure 3 and, while it is fairly self-explanatory, it is perhaps worth expanding on the content of just the top section. Package Hotel, has a 20-minute slot in which to carry out its attack on Al Asad airfield. Four Tornados were to attack the runway(s) – presumably with JP233 – while sixteen F/A-18s attacked other facilities on the airfield, each of these four objectives being identified by its own BEN.[2] This offensive effort was to be supported by three EA-6Bs and ten A-7s tasked with providing SEAD while top cover was provided by eighteen F-14s. There were

[2] BEN – Basic Encyclopaedia Number; a code that identifies a specific potential target, the details of which are contained, originally in a book, now on an electronic database, maintained by the US Department of Defense, that covers the whole world.

TOT*	MSN*	BEN	TGT	DESCRIPTION	A/C
	1031L	AL ASAD AREA		SEAD	6 A-7
PKG	1061L			SEAD	4 A-7
H	1071P,06P			SEAD	3 EA-6B
0630-50	1001G	0427-08868	A19	AL ASAD AFLD RWY	4 GR-1*
	1005G			RECCE	GR-1A
	1011H	0427-08868	A19	AL ASAD AFLD FAC	6 F/A-18E
	1021H	0427-08868	A19	AL ASAD AFLD FAC	6 F/A-18
	1065H	0427CA0373	SAD30	H-1 NE IOC	4 F/A-18
	1037D			FORCE PROTECTION	2 F-14
	1041D/45D			FORCE PROTECTION	8 F-14
	1051D/55D			FORCE PROTECTION	8 F-14
	1027I/07I			TANKER	4 KA-6
	10751			TANKER	4 KA-6
0700-10	1161W	BAGHDAD AREA		SEAD	8 E-4G
PKG	1171X			SEAD	2 EF-111
I	1111G	0427-08023	A02	AL TAQADDUM AFLD RWY	4 GR-1
	1115G			RECCE	GR-1A
	1121F	0427CA0410	MS27	FALLUJAH PROB SCUD PLANT	8 F-16*P
	1131F	0427CS0037	MS31	SHAMIYAT ROCKET ENGINE PLANT	8 F-16*
	1141F	0427CS0031	MS32	HABBANIYAH ARTILLERY PROD	8 F-16*
	1151F	0427CS0032	MS33	HABBANIYAH MILITARY PROD	8 F-16*
	1202C,11C			SWEEP	8 F-15C
	* 363 TFW COORDINATE INGRESS/SEAD/SWEEP WITH PKG J/K				
	K1256			DRONE SUPPORT	6 BQM-74
	J1351X	LATIFIYA AREA		SEAD	2 EF-111
	J1331,W			SEAD	8 F-4G
0710	J1301F	0427CS0033	C10	LATIFIYA SOLID PROP PLANT	8 F-16*P
0720	J1321F	0427CA0411	MS23	LATIFIYA LIQUID PROP PLANT	8 F-16*
PKG	J1361F	0427CA0112	MS14	LATIFIYA SUSP SCUD PROD FAC	8 F-16*
J	J1341F	0427CS0035	MS25	LATIFIYA EXPLO A AMMO PLT	8 F-16*
	J1371F	0427-00938	MS30	AL ISHKANDARIYAH ARMS PLT	4 F-16*
	J1311F	0427CA0311	MS28	AL MUSAYYIB ROCKET MOTOR TEST	4 F-16*
	J1315F	0427CA0408	MS24	LATIFIYA SSM EQUIP PROD	4 F-16*
	J1201,11C			SWEEP	8 F-15C
	1251C			SWEEP	4 F-15RS

Fig 3. A page from the first part of an Air Tasking Order, each line of which was considerably amplified by the second part.

eight KA-6 tankers, probably for the A-7s, and a single Tornado GR1A for post-strike recce. This, fairly typical, package amounted to some sixty aeroplanes but at the other extreme, an F-117 sortie might be totally unsupported and thus be a single line.

It will be evident that the first part of an ATO presented only a summary of each event. The second part expanded in considerable detail on each of the individual lines in the first part. Each Mission (MSN) would be assigned to a specific unit which would be told how many aircraft to prepare and what weapons to load. Callsigns would be allocated, along with a series of primary and secondary radio frequencies to permit the crews to communicate with other elements in the package, the AWACS and any other agencies involved. SIF/IFF codes would be specified. Times and locations of rendezvous would be spelled out, along with any routing or height restrictions; the availability and locations of tankers would be notified and so on. Thus, while it was not possible to tell from Figure 3 what weapons the Tornados would be delivering, or who the KA-6s were hauling fuel for, this would all be spelled out in the second part of the ATO. So each of those single lines in Figure 3 would become perhaps twenty and with about 2,000 sorties being flown every day, the whole ATO could run to 5,000 pages.

All of this activity, concentrated in a relatively confined area, required a disciplined approach to flying which was achieved by the imposition of an airspace control plan. Figure 4 covers roughly the border between Iraq and Saudi Arabia. with Jordan at top left and Kuwait at bottom right. Being reproduced as a monotone, reduces the impact somewhat, but each of those overprinted symbols, which were colour-coded in red, green, blue and black, represents a restriction of some kind – E-3 orbits, RIVET JOINT orbits, tanker tracks and much else.

While it was not an RAF resource, it is, I think, appropriate to highlight the F-117. DESERT STORM was its first outing, so it was something of an unknown quantity. When they arrived in theatre, the straight-talking Chuck Horner interviewed the Detachment Commander. ‘I don’t want to know what you think you can do,’ he said, ‘or what you hope to do. I need to know what you *can* do.’ The response was, ‘We will arrive over our targets undetected and we will

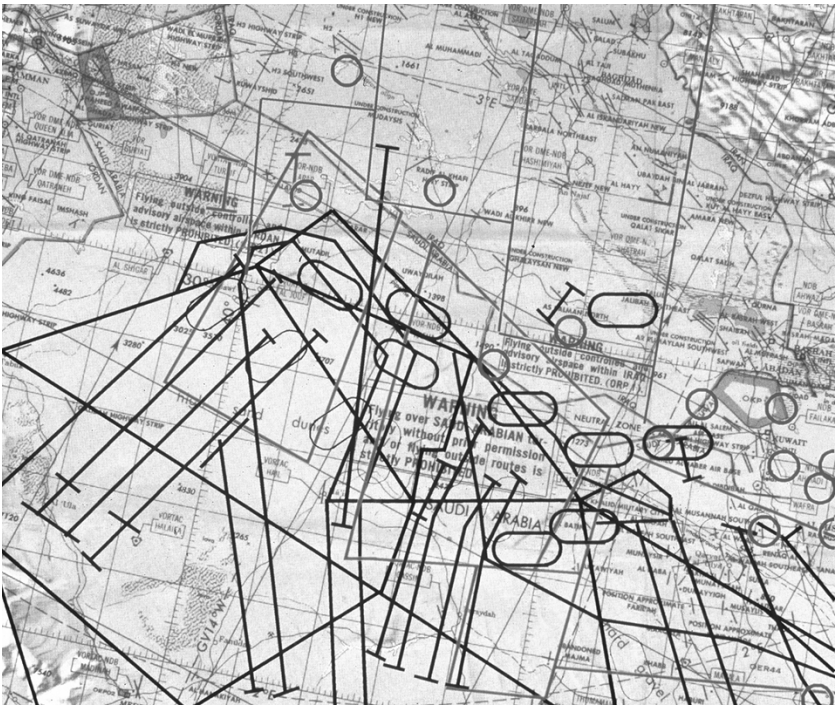


Fig 4. While it lacks something as a monotone, this image still conveys some impression of the complexity of the airspace control arrangements.

place our I-2000 LGBs[3] through whichever windows you choose to nominate.' And he wasn't exaggerating.

The F-117 was a notable success story, one of two. The other one was the LGB itself. A lack of marking capability meant that there was some delay in the RAF's being able to employ LGBs but this shortfall was overcome by the arrival of Buccaneers towards the end of January, and receipt of four early examples of GEC Ferranti's thermal-imaging, laser-designating (TIALD) pods at Tabuk in early

[3] The I-2000 (I for Improved)-2000 LGB is probably better known as the GBU-24 (or, specifically for the F-117, the GBU-27) 'bunker buster', a 2,000 lb BLU-109B high-strength forged steel penetrator warhead combined with a Paveway III laser guidance kit.

A Laser Guided Bomb on an RAF Tornado. First used on a relatively large scale during Operation GRANBY/DESERT STORM, the precision with which LGBs were delivered ushered in a new era in the effectiveness of air power.

February. From then on the Tornados were able to attack precision targets – a single bomb on a bridge in the middle of a built-up area, for instance, or an individual HAS on an airfield. To conserve rapidly dwindling stocks, of both bombs and Paveway kits, we eventually reduced the load from three to two. It was inevitable that there would be instances of bombs failing to guide and simply falling ballistically, which could have unfortunate results. On one occasion a visiting Minister asked me why this was happening – were we doing it properly? I advised him, tactfully, of course, that the reliability of our bombs reflected the level of funding that the Treasury permitted us to invest in weapons technology.

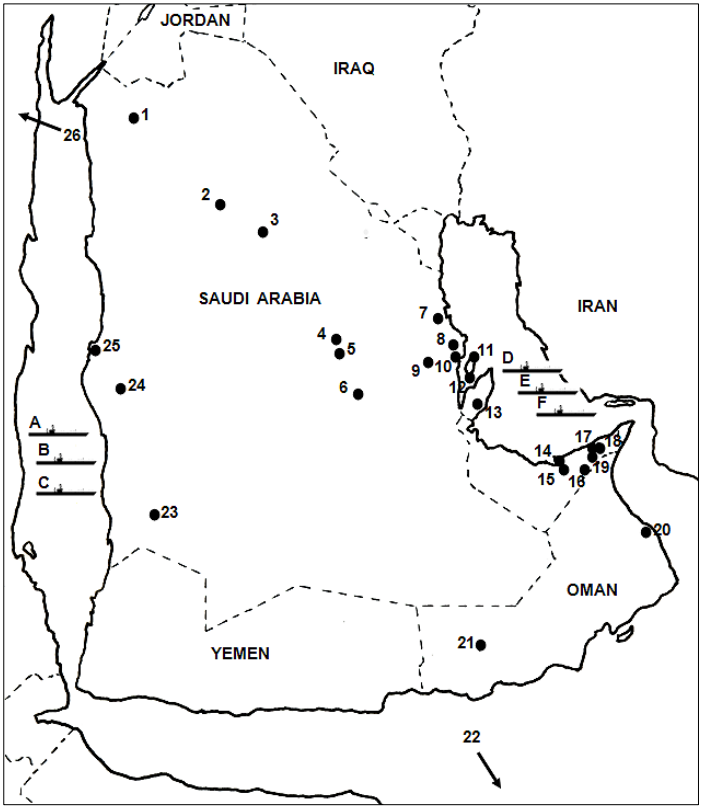
The LGB aside, I should also say something about the Tornado and the RAF's unique JP233. JP233 had been acquired specifically to close 'NATO-sized' airfields in eastern Europe, and to keep them closed by revisiting them with further JP233s every eight hours or so. But the Iraqi airfields were two or three times the size of Heathrow and we calculated that we could have closed three, at the most, had we pursued European tactics. Horner concluded that this was neither

practical, nor indeed necessary. Rather than attempting to neutralise airfields completely, he opted for heavy harassment, the result being a multi-faceted attack – like Package Hotel at Figure 3. I would just add that, without exception, the Tornado crews were *all* dropping JP233 for the first time, mostly at night, in a profile that was, by any stretch of the imagination – hazardous. And they did it with enormous skill, considerable precision – and a great deal of courage. The fact that we did not employ JP233 conventionally, that is to say in the manner in which we would have done in Europe, caused eyebrows to be raised in some quarters, but there is no doubt that we were right to adapt the procedure, to tailor our tactics to match the targets.

Having begun on 17 January, the air campaign continued remorselessly until General Schwarzkopf assessed that the level of damage inflicted on the Iraqis was such that it was time for his land campaign to begin. Launched on 24 February, it lasted less than five days and it was quite clear that the capability of the Iraqi Army in the desert had been reduced by, at least, the 50% that had been required and it was ready to call it a day.

By 24 February the Iraqi Army was ready to call it a day.

Annex A – Airfields Used By Fixed Wing Aircraft.



1. Tabuk
2. Hail
3. Gassim
4. King Khalid International Airport, Riyadh
5. Riyadh
6. Al Kharj
7. King Abdul Aziz Air Base, Al Jubail
8. King Fahd Airport, Damman
9. Dhahran
10. Al Ahsa Air Base, Bahrain
11. Bahrain International Airport, Muharraq
12. Sheikh Isa Air Base
13. Doha, Qatar
14. Bateen, UAE
15. Abu Dhabi/Al Dhafra, UAE
16. Al Ain, UAE
17. Dubai, UAE
18. Sharjah, UAE
19. Al Minhad, UAE
20. Seeb, Oman
21. Thumrait, Oman
22. Diego Garcia
23. Khamis Mushait
24. Taif
25. Prince Abdul Aziz Airport, Jeddah
26. Cairo West

A. USS *Saratoga*
B. USS *America*
C. USS *John F Kennedy*
D. USS *Ranger*
E. USS *Midway*
F. USS *Theodore Roosevelt*

Annex B – Order of Battle of Armed Fixed Wing Aircraft.

There are marginal differences between published figures for the numbers of aircraft available, these variations possibly arising from the effective dates, which may, or may not have reflected losses. The figures presented here for US aircraft have been extracted from Table II.2 of *Operation Desert Storm – Evaluation Of The Air Campaign*, the United States General Accounting Office's Report, GAO/NSIAD-97-134, which was submitted to the Ranking Minority Member of the House of Representatives' Committee on Commerce in June 1997.

The aircraft carriers with their embarked Air Wings (CVW) were the USS *Saratoga, America* and *John F Kennedy* in the Red Sea and the USS *Ranger, Midway* and *Theodore Roosevelt* in the Persian Gulf.

While this paper deals only with fixed-wing aircraft it should be acknowledged that there were, in addition, 1,651 US helicopters in theatre by 16 January, of which 257 AH-64 Apaches and 201 AH-1 Cobras were in the attack role.[1]

Type	No	Basing
USAF, USN and USMC		
A-6E	115	Sheikh Isa & CVWs
EA-6B	39	Sheikh Isa & CVWs
A-7E	24	CVWs
A-10	132	Damman
AC-130	8	Damman
AV-8B	62	Al Jubail (+25 in reserve at sea)
B-52	66	Jeddah, Moron, Fairford, Diego Garcia
F-4G	60	Incirlik, Sheikh Isa
F-14	100	CVWs
F-15C	124	Tabuk, Incirlik, Al Kharj, Dhahran
F-15E	48	Al Kharj
F-16	247	Incirlik, Al Kharj, Al Dhafra, Al Minhad, Doha
F/A-18	169	Sheikh Isa & CVWs
F-111E	18	Incirlik
F-111F	66	Taif
EF-111	24	Incirlik, Taif
F-117	42	Khamis Mushait

RAF		
Jaguar	12	Muharraq
Tornado GR1/1A	50	Muharraq, Dhahran, Tabuk
Tornado F3	18	Dhahran
Buccaneer	12	Muharraq
Saudi Arabia		
F-5E/F	84	Taif, Khamis Mushait, Tabuk, Gassim
Tornado IDS	28	Khamis Mushait, Dhahran
Tornado ADV	24	Khamis Mushait, Dhahran
F-15	81	Taif, Khamis Mushait, Dhahran, Hail
Hawk	30	Dhahran
France		
Jaguar	26	Al Ahsa
Mirage F1	12	Doha, Al Ahsa
Mirage 2000	12	Al Ahsa
Italy		
Tornado IDS	10	Al Dhafra
Canada		
CF-18	18	Doha
Bahrain		
F-16	12	Sheikh Isa
F-5	12	Sheikh Isa
Kuwait		
Mirage F1	15	Taif
A-4	19	Dhahran
UAE		
Mirage 2000	64	Al Dhafra
Qatar		
Mirage F1	12	Doha

[1] The figures for helicopters are drawn from the April 1992 *Final Report To Congress On The Conduct Of The Persian Gulf War*, which may be accessed on-line at http://www.ndu.edu/library/epubs/cpgw.pdf

OFFENSIVE OPERATIONS TORNADO

Air Cdre Jeremy Witts

Having joined the RAF in 1968, Jerry Witts flew Vulcans in Cyprus and the UK, before completing two tours on the Buccaneer at Laarbruch. Staff appointments followed in the mid-'80s and in 1989 he took command of No 31 Sqn. During the 1991 Gulf War he commanded the Tornado detachment at Dhahran with distinction and was admitted to the DSO. On promotion to group captain he was Executive Officer to the USAF 4-star Commander at Ramstein, and then commanded RAF Northolt before promotion to air commodore and tours at MoD and as Air Attaché to the USA. Since retirement he has been Director Finance & Administration at Birkbeck College, University of London.

I'm sure that everyone has experienced one of those moments, when suddenly you think , 'What the goodness am I doing here?' For me, one of those moments came a couple of minutes after midnight GMT on 17 January 1991, when I found myself leading a formation of Dhahran-based Tornado GR1s flying at just under 200 feet at 500 knots about 30 seconds from releasing our JP233 airfield denial weapons on what we hoped was an unsuspecting Iraqi air force base. Simultaneously, formations from our sister Tornado detachments from Muharraq and Tabuk were attacking two other air bases. Then, ahead of us in the darkness, blinking lights started to appear. I asked my navigator 'What are those flashing lights, AJ?'

'Flak you idiot!' was his stern reply.

Very quickly, the flashing lights became white stair rods arcing over and around us. Away to the right, the sky erupted in orange flames, quickly followed by a curtain of incandescent white lights as more and more anti-aircraft artillery (AAA) fired a barrage into the darkness. There were a hundred fleeting experiences, far too rapid to recall in any detail, as we dropped our weapons and ran away bravely at 550kts, carefully not using the afterburners in order to minimise our IR signature.

So what was I doing there? Well, as I subsequently discovered, somewhat ironically, it was the 23rd anniversary of Harold Wilson's

statement to the House on 16 January 1968 that the UK would be withdrawing from Singapore and Malaysia by the end of 1971, and from the Gulf by the same date, and that the UK did not thereafter plan to maintain a special military capability for use in this area. It's funny how things change.

Leaving that aside, let's go back to 2 August 1990,when, in yet another example of my talent for being in the wrong place, on the very day that Iraq invaded Kuwait I was leading my squadron from Germany to Goose Bay in Canada for a routine low flying training detachment. On the 7th, news came from our home base at RAF Brüggen that they had been told to prepare to send twelve Tornados to Bahrain, with a mixture of twenty-four crews drawn from our sister Nos IX, 14 and 17 Sqns. Tornado F3 air defence fighters were being sent from the UK to Saudi Arabia and Jaguars were off to Oman. In addition, I was told to expect that our planned return to Germany would be delayed, because of the need to devote RAF air transport assets to the reinforcement of the Persian Gulf area as part of the newly christened Operation GRANBY – the UK's military response to events in Kuwait. Hitherto, if crisis aircraft deployments had been necessary, they were usually mounted by UK-based squadrons. Our Germany squadrons were usually left in place to maintain NATO's constant guard. The fact that our fellow Brüggen squadrons were now getting involved indicated that things were really warming up. So much for the Warsaw Pact, but here we were, in my opinion, the finest Tornado squadron in the RAF stuck in Canada, over 5000 miles and an ocean away in the wrong direction! We felt more than a little put out.

In the event, we got back to Brüggen almost on schedule and, inevitably, questions soon arose about how long the Bahrain detachment would last and what would replace it. Understandably, there was no clear view on this because so much depended on what Saddam Hussein would do next. The allied forces that had been sent so far were to bolster defences in the region and to counter any further Iraqi aggression. They were not there to remove the Iraqis from Kuwait – nor were they by any means sufficient to do so.

One thing was clear, however; there was no official requirement for me to prepare my squadron to go out to the Gulf, but we did what we could anyway. I consoled myself with the thought that, even if we

wouldn't be involved in the Gulf right now, it was a reasonable bet that our chance would come in due course.

On 14 September it was announced that another Tornado GR1 squadron would be sent out to the Gulf, to Tabuk in Saudi Arabia. However, to our disappointment, it soon became clear that this would be found from the other Tornado GR1 bases. Nevertheless, there was still the Bahrain rotation to hope for. At last, sometime during the closing days of October I was told that we would be going.

The brief was fairly straightforward. Pending Cabinet approval and an official announcement, Brüggen was to produce another detachment of twelve Tornados with twenty four crews to go to an unspecified Gulf destination on an unspecified date, which eventually turned out to be Dhahran in Saudi Arabia in the first few days of 1991. No 31 Sqn was directed to provide the core of the detachment, which meant that virtually all my groundcrew would have to go, as well as all the available combat ready crews that I had left.

At that time, each Germany-based Tornado squadron had twelve aircraft and fifteen crews as its establishment, although some were in the process of reducing from a former establishment of eighteen crews. Thus, some squadrons, including mine, actually had more than fifteen crews 'on the books'. These were supported by a squadron engineering establishment of approximately 130 personnel,

We frantically got ready, not least trying to give all the crews, especially those who would be joining my detachment from the other three Brüggen Tornado squadrons, the same amount of relevant training that my own team had managed to amass. Over Christmas, I was tipped off that an additional six Tornado GR1A reconnaissance aircraft with crews and ground crew might eventually be joining my detachment. You will perhaps understand my concern at the possibility of having to put together, at short notice, a coherent team drawn from six different squadrons and including three other Squadron Commanders.

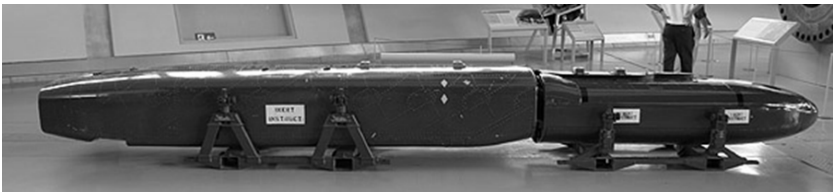
Eventually, during the first few days of 1991, the Brüggen elements of my detachment arrived safely at Dhahran alongside Nos 29 and 43 Sqns which, together made up the already resident Tornado F3 detachment and, thanks to some fantastic work by all concerned, we managed to get everything and everyone accommodated. There was no more news about the recce jets but Air Headquarters in Riyadh

The Portakabins at Riyadh that accommodated Air HQ for the British contingent in-theatre.

had directed that each crew should complete a minimum of four in-theatre training sorties before I could declare my detachment operational. That seemed very sensible; however, with less than two weeks to go to the UN's 15 January deadline for Iraq to vacate Kuwait, we were going to have our work cut out to achieve the 96 sorties required.

On 4 January, I was summoned with my aircrew Weapons Leader to the UK Air Headquarters in Riyadh. We were hungry for information, so this was very welcome. Despite its rather grand title, Air Headquarters was actually a couple of white-painted Portakabins erected in the car park of the Royal Saudi Air Force Headquarters. Now, that was a rather grander edifice, as we soon discovered on being ushered through its modern airy halls to our conference room. The meeting was chaired by the Air Commander, Air Vice Marshal Bill Wratten, and among the others present were Wg Cdre Ian Travers-Smith, OC 16 Sqn from Laarbruch and now boss of the Tornado detachment at Tabuk, Wg Cdre Mick Richardson, the RAF's representative in the Coalition air targeting cell, and the Chief Scientific Research Officer from Headquarters Strike Command at High Wycombe.

The essence of the meeting was a presentation of the Chief



The 21½ foot long, 2½ ton JP233. The Tornado could carry two of these monsters.

Research Officer's analysis of the most effective tactics for using JP233 on some of the likely targets. It seemed clear that our Tornados had been contracted to the Coalition to concentrate on high value Iraqi airfields in order to limit their flight activity to levels that the Coalition's air defence fighters could cope with. Whether the RAF had proposed this or had been asked to do it, it was an obvious role for the Tornado, albeit a rather daunting one given the scale of the task and the likely defences. Aside from the overall number that would have to be dealt with, the problem with Iraqi airfields was their vast individual extent and the considerable redundancy of available take-off and landing surfaces. The Iraqis had obviously been very well advised.

Typically, an aircraft in one of their hardened aircraft shelters had several options for getting to at least two full sized runways, each usually at least 10,000ft long. Indeed, in the case of the MiG-29 *Fulcrum*, had they chosen to do so, there was usually sufficient space for it to take off straight ahead, directly out of its hardened aircraft shelter, on its own 800 metre taxiway. In sum, any one of their airfields would present a formidable task for us. We could each carry two JP233s. At 21½ ft long and each weighing 5,150lbs (2,335kgs) they comprised canisters of 215 HB-876 area denial mines, and thirty SG-357 runway cratering bombs. However, they could only be dropped in a single swathe. We could vary the length of that swathe but it was going to be difficult to find ways to produce enough 'cuts' on the Iraqi operating surfaces to chop the airfield into lengths short enough to render them unusable by their aircraft, particularly when we started to take into account the known and likely positions of defending SAMs and AAA and the limited surprise that we were likely to achieve with large formations of aircraft. We all took copious notes. The meeting was very enlightening and all the information

would be vital when we received our actual targets to plan.

After the meeting, AVM Wratten took me down to his office, where he came straight to the point and asked whether I could accept an additional six Tornado GR1A reconnaissance aircraft as part of my detachment? Thank goodness I had been tipped off! Naturally, I answered 'Yes' and we discussed how many additional groundcrew we would need. I was told to expect the additional aircraft on the 14 January, which was getting very close to the UN deadline.

Then Mick Richardson grabbed us, telling us that he wanted to 'read us in' to the war plan. He led us down to the deeper basements of the RSAF HQ, where, after numerous security checks, we found ourselves in a room surrounded by USAF personnel, all busily working away at computers. Mick informed us that this was the, now famous, 'Black Hole'[1] and stressed the utmost secrecy of what we were about to see and hear. Despite having signed the Official Secrets Act, we were required to sign an additional declaration that, under threat of dire consequences, on no account would we divulge the information that we were going to receive. Only those with a strict 'need to know' were being told. Mick went on to tell us that when he gave us targets, as he would in a few days' time, we alone should carry out the planning for them until others were 'read in'.

Suitably impressed, we listened intently as he and a USAF colleague revealed the logic behind the planned Coalition air campaign, its aims, and then, the current version of the detailed Coalition Air Tasking Order (ATO) for the first 24 to 48 hours. I was staggered. Although quite simple in concept, it was breathtakingly complex in detail. The way in which individual tasks, missions and supporting elements interleaved was a masterpiece of planning. There was even a computer display to demonstrate that there would be no mid-air conflictions provided, of course, that everyone stuck to their part of the plan and followed the airspace control orders correctly. In the words of a later United States Air Power Summary,[2] the plan:

> 'sought to dislodge the Iraqi forces from Kuwait by attacking Iraqi targets including: leadership and command and control systems; key nuclear, biological, chemical, electrical, military and oil production facilities; bridges, railroad, port infrastructure; and air defence, naval, missile, and ground

A clutch of Tornados, at least three of them armed with JP233, queuing up to take on fuel from a Victor.

forces, particularly the Republican Guard.'

Mick Richardson was true to his word and few days later we were busy planning the first batch of airfield targets.

All in all, under the watchful eye of our recently arrived overall Dhahran detachment commander, Gp Capt Cliff Spink, preparations were going pretty well but there was bad news to come on 13 January when we lost one of my No 14 Sqn crews on a training sortie at low level in Oman and the sad fact emerged that Flt Lts Kieran Duffy and Norman Dent had flown into the desert. It was a sobering reminder of the risks involved.

My recce Tornados eventually arrived so, by the 15th of January there were three operational Tornado GR1 detachments in theatre: Muharraq and Tabuk, each with twelve GR1s and twenty-four crews and Dhahran with twelve GR1s, six GR1As and thirty-six crews.

On 16 January the UN deadline passed at 8am local time. Air Headquarters had already ordered us to 'load to the Frag'– the Fragmentary Order that gave the detail of the overall Air Tasking Order although, as yet, with no datum time or 'H-hour' for execution.[3] That evening, I received an urgent summons to report back to work. Cliff Spink met me and took me to my office before showing me a brief top secret signal from Air Headquarters stating that H-hour

would be 0001 GMT on the 17th, ie one minute past three local time the next morning.

As already described the first sortie was pretty ‘interesting’, not least taking off at such an enormous AUW for the GR1and tanking from Victors in very choppy conditions. Anyway, just over four and a half hours later we were safely back and climbing aboard the crew bus to take us back to the squadron for a full debriefing. The boys were exhausted and emotionally drained. As we slumped into the comfortable chairs I pulled out my cigarettes and lit one but my nav ‘AJ’ grabbed it and started to puff away:

‘Hey, AJ!’ I exclaimed. ‘You don’t smoke’

‘I know,’ he replied.

My intention was that each of my four-ship formations should have the opportunity to get into action as soon as possible. Whatever their comparative skill and experience levels, I wanted them ‘blooded’ as soon as possible so that no one felt excluded or had the opportunity to harbour growing fears about flying a real war sortie. This would be particularly important if we started to suffer losses. However, as if on cue, we heard the bad news that one of the Bahrain Tornados (Flt Lts John Peters and John Nicholls) had been shot down that morning. This was very bad news, but not unexpected on such hazardous missions.

In fact, in addition to our training loss, a total of six further Tornado GR1s would be lost in combat during the conduct of air operations against Iraq with five aircrew killed. Most of these were during the first week of low level ops, which, understandably, prompted a review of tactics. The fact was that, by now, the Iraqi air force had effectively been grounded or had fled to Iran, so why take risks at low level when we could operate at higher levels, usually above the AAA?

So, there was a change of emphasis to larger infrastructure targets such as oil and storage. For these medium level missions, almost always with very welcome USAF EF-111 and F-4G *Wild Weasel* support, we could carry up to eight standard 1000lb bombs, but with radar-aimed free-fall deliveries from above 20,000 feet the problem was always going to be accuracy. This was quite simply not the Tornado’s natural environment. We tried various techniques to improve things but the results, except on the biggest sort of targets, such as oil refineries were frustrating.

Following the switch to medium level bombing, pending the availability of a laser-designation facility, the Tornados were obliged to deliver 'dumb' 1,000 pounders with limited accuracy.

From 23 January we were asked to double our flying rate to produce two eight-ship bomber waves a night, which was something of a challenge, given our aircraft serviceability and the spares supply situation. That same night we lost another aircraft when one of its bombs exploded prematurely underneath the aircraft. Eventually, we discovered that the crew had survived but had been taken prisoner (*see Journal 56, pp 133-140*).

Thank goodness, therefore, for the decision soon afterwards to introduce Buccaneers, with their Pavespike laser designation capability, into theatre. They were collocated with the Tornados in Bahrain, but from 5 February they also supported those operating from Dhahran and Tabuk. This entailed a shift to daylight operations and, with a package usually involving two Buccaneers and four Tornados, we were able to stop acting like modern day Lancasters and start taking out bridges and hardened aircraft shelters with surgical precision.

However, there were some initial co-ordination issues. With our Buccaneer designators based in Bahrain, to stand any chance of success, each sortie required very careful co-ordination and an agreed set of standard operating procedures. The necessary arrangements were already in place, thanks to some intensive work at Bahrain, but we had problems actually getting our planning information across to

Following the deployment of Buccaneers, the Tornados were able to deliver Paveway II LGBs with extreme precision.

Bahrain, a mere 40 miles or so away. These were pre-internet days, of course, and for various reasons, our secure fax machine had very little bandwidth and could communicate with Bahrain only via London, which meant inevitable delays. To work around this, I arranged for an Int Officer to be standing by to hand-carry a copy of our plans across to Bahrain, but it was hardly an efficient way of doing business.

I also took the time to track down Sqn Ldr Norman Browne at Muharraq on a secure telephone link and discuss the issues with him at length. Besides being the RAF's acknowledged expert in Pavespike laser designation, and being deeply involved in running the Bahrain Buccaneer detachment, Norman had once been my own navigator on Buccaneers when Pavespike had been introduced into RAF Germany and he was a close friend. Thus, we were able to cut through the surrounding trivia and get to the heart of the problem. From our shared experiences we knew that, in essence, all that the Buccaneers needed from us was a rendezvous position and time, an agreed set of aiming points and an agreed attack direction, plus an agreed set of codewords to indicate when the Buccaneer's laser was firing and that our bombs had been released. After all, wasn't that how we had done it with the Jaguars seven years previously? Such information could be passed in a 30 second 'phone call without the need for special couriers and intercontinental secure fax lines. On the other hand, as Norman

explained, the Buccaneers had been rushed out to perform this role and some of the navigators were relatively new to Pavespike, operating it with real weapons for the first time on their first trips over Iraq. Understandably, they not only wanted things to be straightforward but also to have everything checked and rechecked to ensure that things went well.

On 10 February there was another review meeting at Air HQ. Air Cdre Trevor Nattrass, one of the Deputy Directors of Operations in the UK Joint Headquarters at High Wycombe, would be visiting and, understandably wanted a meeting to discuss bombing methods, which developed into a fruitful discussion about laser bombing techniques and the need to avoid collateral damage. Trevor also gave us an excellent résumé of the MOD's efforts to replenish our dwindling bomb supplies and to track down suitable stocks from around the world. It was also agreed that we should expect to move away from the 'dumb' bombing of petroleum storage sites. Hopefully, we would soon have sufficient laser designators in place to support three laser bombing four-ships a day.

Next day, my own formation was scheduled to fly again against Al Assad airfield near Baghdad. However, when AJ and I arrived at the squadron at about 0815 we found ourselves with a major re-planning exercise on our hands. Air Headquarters had issued additional instructions on the avoidance of collateral damage, which had to be factored-in to the existing long list of considerations, such as the need to avoid hitting religious or archaeological sites.

Against this background, we were nudging the capability limits of our co-operative Buccaneer/Pavespike and Tornado/Paveway Laser Guided Bombing system and a small proportion of bombs sometimes failed to receive the reflected laser energy that should have guided them to their targets. Such bombs usually fell short of the target and because of the safety features inherent in our planning, they fell in open desert. On today's sortie, however, our bombs hit the hardened aircraft shelters they were intended for. Whatever the politics of collateral damage, I found on our return that we had been ordered to cease 'dumb' bombing altogether. In future, as AVM Wratten had predicted, all attacks would be carried out using laser guided bombs.

The reasons behind the sudden flurry of concern about continued dumb bombing and collateral damage soon became clear as news of

the USAF attack on a Baghdad bunker with the loss of 'several hundred' civilians was blazed around the world by CNN. Next day, 14 February, the Iraqis revised the death toll downwards to a still lamentable total of sixty-four but, by then, CNN had already helped the Iraqis to make their point.

That same day, the more restrictive tactics inherent in keeping collateral damage to a minimum and using only laser guided bombs would cause an unfortunate backlash on the Tornado force. There were few enough Buccaneers to go around, so the natural temptation was to use larger numbers of Tornados on a single target area with the Buccaneers remaining in place to provide designation for successive Tornado formations. Wg Cdr Ivor Evans' formation was tasked to carry out one such attack and provide the last four in a twelve-aircraft stream through a single target. Ivor took one look at the plan and refused to take part unless changes were made. As he very sensibly pointed out, it was quite ridiculous, and an elementary breach of sound tactics, to fly twelve Tornados, one after the other, at regular intervals along the same attack track. Even the most inept of defences were bound to have a field day. Ivor's requests for change were refused and so we declined to fly the sortie. It was just as well. The eighth (and now last) Tornado in that stream was hit by an Iraqi SAM. Although we did not know their fate at the time, tragically, the navigator, Flt Lt Stephen Hicks, was killed and his pilot, Flt Lt Rupert Clark, was taken prisoner.

The designator situation was helped immensely by the rapid introduction of two trial Thermal Imaging And Laser Designation (TIALD) pods with the Tabuk detachment. The pods, immediately nicknamed *Sharon* and *Tracy*[4] by the aircrew, were an immediate and very considerable success and removed the need for Tabuk to have Buccaneer designators from Bahrain, 800 miles away on the opposite side of the theatre. The Tabuk detachment was also equipped with the BAE Systems ALARM – its 'air-launched anti-radiation missile'.

Despite the initial frustrations, no analysis of the latter phase of Tornado GR1 operations during Operation GRANBY/DESERT STORM could fail to conclude that the partnership with our laser designating Buccaneer buddies had been anything other than a success. Initially, it may have been a marriage of convenience, but true love eventually blossomed.

Meanwhile, our Tornado GR1A reconnaissance variants with the Vinten Linescan integrated system were busy amassing some 140 operational tactical recce missions. The GR1As operated mainly in pairs at night, at low level and for extended periods over enemy territory seeking a variety of targets, including *Scud* mobile missile launchers, enemy defences and positions, supply routes and bridges for damage assessment after LGB raids. Good imagery of the majority of targets was obtained and no losses were incurred. The GR1As proved especially useful for short-notice tasks, and their results drew particular praise from the Americans.

Eventually, on 24 February, the land war started and by the end of the month, after 42 action packed days, hostilities were terminated.

For the statisticians, the Tornado force of, on average, forty-six aircraft had flown over 1,600 operational sorties (some 3% of the coalition total) for the loss of seven aircraft on operations (some 8% of the coalition total). We had dropped 106 JP233, some 4,400 free fall 1000 lb bombs and 1,100 laser guided bombs as well as launching 104 ALARM missiles.

Eventually, in March, it was time to take the team home to Germany. With my nav, AJ, I led the last four-ship back to Brüggen on the 16th to be, unexpectedly, greeted by the Commander in Chief and the RAF Germany band! It was all very embarrassing. As we taxied to a halt, surrounded by a sizeable crowd, I said to AJ, 'What do I do now?' 'Well,' he said, 'you could try getting out of the bloody aeroplane.'

Notes:

[1] See Hallion, Richard P; *Storm Over Iraq* (Smithsonian Institution Press, Washington DC; 1992) and Olsen, John Andreas; *John Warden and the Renaissance of American Air Power* (Potomac Books, Washington DC; 2007).

[2] United States Air Power Summary – Gulf War (Draft dated 15 April 1993) released for open publication by DOD (OASD/PA) 5 May 93.

[3] 'The Frag' is a colloquial reference to the ATO, probably originating in the Vietnam era.

[4] Characters in the *Viz* adult humour magazine

BUCCANEER OFFENSIVE OPERATIONS

Wg Cdr Ewan Fraser

Having read Electronic and Electrical Engineering at Glasgow, Wg Cdr Fraser joined the RAF in 1986. Trained as a navigator, he flew Buccaneers with No 12 Sqn and Tornados with Nos 14 (twice) and 15 Sqns, all of which included extensive operational experience over Iraq and the Balkans, latterly as a QWI and Flight Commander. Ground appointments have included a stint in the CAOC at Al Kharj and tours with the Personnel Management Agency, on the staffs of HQ 1 Gp and the UK's JFACHQ in Afghanistan. He is currently serving at High Wycombe as the Air Platform Protection (EW) desk officer.

You have heard, from Air Cdre Witts, about the concerns he felt while leading a stream of aircraft over well-defended Iraqi targets, and about the specific incident involving the last Tornado lost to enemy fire. Well, I shared Air Cdre Witts' concern at that time, albeit from perhaps the opposite end of the responsibility spectrum, that of a fresh-faced newly combat-ready junior navigator, and 14 February 1991 is firmly implanted in my mind, as that was the date of my first operational sortie. What is more, I was actually informed of that Tornado's loss during the outbrief for my first mission which was, in effect, the follow-on task to the very same target, the heavily defended Al Taqaddum airfield, just west of Baghdad. I had actually planned my sortie alongside the crew who were now missing in action. I still recall my dryness of mouth – as we walked to our aircraft I could not speak. Two things were in my mind: success and survival.

I am going to talk about Buccaneer operations. I shall make no attempt to address the high level strategy and politics surrounding the aircraft's deployment, or to discuss the complexities of operational command – these issues having already been admirably covered by previous speakers. My intention is to present a view through the tactical lens or, more specifically, through the eyes (as constrained by the extremely limited field of view provided by the optics of a Pavespike pod) of a junior Buccaneer nav. However, I should provide

The Buccaneer in its natural environment, at low level over the sea toting, in later life, as in this case, Sea Eagle missiles.

a health warning. My efforts to keep my head above water at the time – simply trying to understand what was expected of me, never mind recording anything for potential future presentations to distinguished historical societies – meant that I kept no journal nor do I have any notebooks for reference. Thus, what I present here is a personal recollection, perhaps enthusiastically tainted or embellished through time.

I remember clearly when Iraqi forces invaded Kuwait in August 1990 and the Gulf crisis began. At the time only three Buccaneer units remained operational – Nos 12 and 208 Sqns and No 237 OCU, all based at RAF Lossiemouth. They all flew the Mk S2B version of the Buccaneer in the maritime strike/attack role assigned to SACLANT, with the OCU also responsible for a low-level land attack commitment to SACEUR. At the personal level I was participating in an RAF sailing expedition to the west coast of Scotland, a week of leisure as a reward for an intensive year, involving six month's OCU conversion flying followed by a six month work-up to combat ready (CR) status. Looking back, I still recall thinking a year or so later that the misery of the OCU and the torment of my CR training was worse than the ordeal I faced going to war!

My sailing expedition continued uninterrupted and when I eventually returned to the squadron I found that the invasion of Kuwait had changed little, aside perhaps from a sudden appreciation of where Kuwait was situated geographically, and the emergence of a plethora of instant experts on Middle East politics, each with their

own view of how to resolve the crisis – specifically through employment of the Buccaneer of course. However, closer to my near-term junior officer heart, was that a squadron exercise to Turkey had been cancelled for lack of available air transport (AT). Of course I now realise, with the benefit of a further twenty-one years' experience, that while a lack of AT was undoubtedly a factor, the rationale was more likely to have been linked to the strategic implications of deploying a squadron of attack aircraft to one of Iraq's immediate neighbours.

What immediately followed for the Buccaneer force was, well, not much really. For the rest of 1990 the Cold War influence continued – long range maritime strike/attack missions with low-level anti-shipping laser guided bomb attacks being very much the norm. The wing carried on with absolutely no inkling of what was to come – deployment simply was not in the frame. Nonetheless, foreseeing a possible requirement and with potential deployment in mind, the Force commenced some low level overland tactical and target designation training, very aware that, aside from a few laser designation targeting pods in development for the Tornado, the Buccaneer with its Pavespike pod provided the only national airborne laser designation option for the UK. Shortly afterwards, however, I recall my Flight Commander telling me that Lossiemouth had received quite a stern directive from 18 Group to the effect that we were *not* going to deploy to the Gulf and that we should therefore desist from war-mongering and return to working purely on our maritime tactics. Whether this statement was true, or whether it was simply a way of managing our expectations, I guess I will never truly know but I do know the disappointment that it brought. We were also advised that the US military air planners had undertaken to provide any necessary airborne target designation for RAF aircraft.

Christmas 1990 came and went. Our forces continued to build up in the Gulf. We could only observe these developments from afar, with keen interest and more than a little envy.

In January 1991, when news broke that the air war was actually underway, I was at home at Lossiemouth. Listening to the radio at 6am in the morning after the first night of operations I remember being somewhat taken aback, and more than a little relieved, to hear that we had lost only one aircraft – my Cold War training, whether by

design or individual misconception, having led to me to expect far worse. The Met briefing on that cold dark Scottish morning was a sombre affair. All of our minds were elsewhere and youthful concerns were being voiced regarding the futility of training for our maritime role when clearly there was real work to be done elsewhere. But the Flight Commanders pulled us together and we were soon airborne over the sea practising the multi-aircraft attacks that were designed to take out the worst that our potential adversaries' navies could offer. As I recollect it, a few days later, at 'happy hour' in the Mess, AOC 18 Gp, Air Marshal Sir Michael Steer, who had been pushing for a Buccaneer involvement, confirmed that we were unlikely to be required. It still seemed that a Buccaneer deployment was simply not on the cards, especially as the force was currently engaged in exercises with No 12 Sqn down in Gibraltar and No 208 Sqn at St Mawgan. If anyone had told me then, that within two weeks we would be fighting in the war, I simply would not have believed them.

Warfare has but one certainty – it is unpredictable. With the Tornados soon operating at medium level, for reasons already covered by Air Cdre Witts, with their weapons system optimised for low-level it soon became evident that a laser designation capability was required. I believe that, towards the end of the first week of hostilities, Lossiemouth's Station Commander was asked how quickly he could get a squadron of Buccaneers to the Gulf. His response was – six aircraft ready to deploy in three days, once they had been recovered to Lossiemouth. Not long afterwards a Warning Order was issued which directed the Buccaneer Force to prepare for a deployment to the Gulf where it was to provide co-operative, daylight laser designation support for the Tornados. The station became a hive of activity.

The first major task was to modify the aircraft. Immediately apparent was the application of the, by now familiar, Jaguar/Tornado-style 'desert pink' paint scheme – the joke being that if you stood still in General Engineering Flight you would find yourself coated head to toe within seconds. To cater for the unfamiliar electromagnetic environment, both the hardware and software of the radar warning receiver had to be upgraded. *Have Quick II* encrypted frequency-hopping radios and Mode 4 IFF were fitted, both of which would be essential for in-theatre operations. For self-defence, our ageing AIM-9G Sidewinders were replaced by AIM-9Ls. That all of this was

A Buccaneer in hastily-applied, but immaculate, 'desert pink'.

done, tested and declared operational in a matter of days was clear evidence of the effort, resourcefulness and single-mindedness-of-purpose demonstrated by personnel across the board, not just at Lossiemouth, where these traits were readily apparent, but across the whole of the Defence establishment. With hindsight, I was probably naïve not to have to concluded that someone, somewhere had not already given some thought to what might be required but, even so, it was a remarkable performance.

Modification of the aircrew was the second major task. Those selected to deploy – I was not among them, as the initial selection was confined to experienced operators – had to be equipped with what they needed from NBC suits to an assortment of injections and medical preparation. Perhaps more importantly, procedures for laser target designation from medium level had to be developed. Although laser designation was part of the regular Buccaneer training programme, it was always done at low level and, aside from the OCU crews who had their overland role, it was practised exclusively against maritime targets. Therefore, in order to develop and validate the tactics, techniques and procedures that the deployment would subsequently use, the squadron's Qualified Weapon Instructors and other senior operators took to the air whenever they could in whatever suitable aircraft were available – remembering, of course, that the majority of the aircraft fitted for, and equipped with, the Pavespike laser pod were undergoing modification or in the paintshop. In addition, some of the OCU crews required a rapid familiarisation with air-to-air refuelling, a

Air-to-air refuelling was an un familiar technique for ex-RAFG crews but would be essential both for deployment and in-theatre operations.

discipline of which they had no previous experience through having spent their earlier front line tours in Germany, where there was no AAR requirement.

In very short order, six Buccaneers were flown out to Muharraq via a non-stop nine-hour transit. They were launched as three pairs on consecutive days starting on 26 January, with six more crews, along with more than 200 groundcrew, having already left by Hercules.

Following a couple of in-theatre training flights with the Tornados, the first Operation GRANBY Buccaneer mission was flown on 2 February. It was a successful interdiction of the As Samawah highway bridge, in a co-operative laser designation support role and the format of this first mission was to become the baseline. I will come back to this format shortly. Within a week of commencing ops, nine crews were operational with their success leading to increased tasking, the only constraints being the numbers of aircraft, of crews, and of daylight hours, the Pavespike pod having no night capability.

Meanwhile, on Friday, 1 February, I had been informed that I was to be one of six crews standing by to deploy with six further aircraft. My pilot was to be Fg Off John Sullivan, a great friend and pilot, both of us having recently graduated from the OCU and newly rated as combat-ready. I felt very proud to be one of only a handful of first-tourists selected; indeed we were the only first-tourists to be paired as a crew. For me, this meant a weekend of concentrated flying with one of the squadron's Qualified Weapon Instructors who introduced me to the new discipline of medium-level co-operative target designation. We also completed some self-designation high-angle dive attack

training. Whether I impressed or not I cannot recall, but I was satisfied to note that a 'DCO' – duty-carried-out – was entered in the Authorisation Sheet. This, and visits to Stores and the medics completed my preparation.

Orders to deploy the remaining six Buccaneers followed very quickly on the heels of the success of the 2 February mission and another on the 3rd. This would place a total of twelve aircraft and eighteen crews in-theatre. For a first-tourist, the transit flight was quite an adventure. It was a cold, wet, pitch black Scottish morning as we took off as Number Three of a three-ship at about 0600 hours. About 90 minutes later I distinctly recall the beautiful sight of the sun rising over the English Channel as we approached the first tanker bracket with a Victor. A direct sortie, we reached Muharraq, once again in the dark, after a total flight of some nine hours. Our arrival remains clear in my mind.

Having departed from the last tanker, the plan was to arrive as single aircraft in trail from the south east. The Buccaneer's navigation kit was not the best and, suffice to say that, after nine hours at medium level above cloud it really did not resemble the real world. Nevertheless I was confident that Muharraq, at the northern end of Bahrain island, would show on the radar, and, so far as we were aware, there was only one major airfield. But confusion reigned during the approach when we saw a clearly lit up runway of significant size to the left of the aircraft's nose. My pilot rationalised – logically, of course – that without the benefit of accurate navigation information or radar displays, this must actually be our destination. But I could clearly see that this was not the case, as my radar showed this runway to be in the middle of the main island. Thankfully, my argument prevailed and we ignored this airfield – which turned out to have been the recently constructed Sheikh Isa Air Base, so recently constructed that it did not yet feature on aeronautical maps – and pressed on until Muharraq came into view. We landed a few minutes later, absolutely exhausted, but exhilarated.

My initial impression was of organised chaos – aircraft, personnel, weapons and vehicles charging purposefully in every direction. While climbing down the aircraft steps I heard a loud bang, and on looking over my shoulder I saw that a fuel bowser had reversed into an RAF Regiment Land Rover. The resolution of this incident, which would

The usual procedure was for a strike to be carried out by six aircraft, operating as two elements, each comprising a pair of Tornados and a Buccaneer 'spiker'.

have required at least a Unit Inquiry back in the UK, simply involved the hefty application of a right boot to disengage the interlocked vehicles.

But, getting to the Gulf was only the first of many challenges.

Co-operative bombing was not the simplest of tasks. It was a complicated business that required extremely close co-ordination which, in an ideal world, would be predicated on familiarity with the procedures, underpinned by a regular training regime. But in Op GRANBY, the technique was very new, to both the Buccaneer and the Tornado crews, and there was no time to spare for practice. So we were, in effect, thrown in at the deep end – but we coped.

The standard procedure was for a pair of Buccaneers to accompany four Tornados, the first Buccaneer designating a target, or targets, for the laser guided bombs (LGB) dropped by the first two Tornados and the second for the second pair. The over target time between Tornado pairs was normally separated by two minutes, reducing to one minute if each Tornado had a different target. With a bomb's time of flight being around 40-45 seconds, this spacing allowed each Buccaneer to laser designate, or 'spike', up to two separate targets for each Tornado pair; and also ensured that, should only one Buccaneer be available for whatever reason – perhaps an in-flight unserviceability or the other crew having difficulty identifying a target – that it theoretically had time to identify and 'spike' all four targets.

Other factors ate into the limited time that was available, such as the distance between targets and the need to allow time for dust and

Left, an LGB strike on a bridge as seen on the Navigator's TV display and, right, on a different bridge as seen with a camera.

debris to settle, and to allow the Buccaneer navigators to 'map read' or 'walk' their targeting pods over features on the ground from one target to the next.

Furthermore, positive identification of the target, or the target area, which would permit the actual target to be positively identified while the weapon was in flight, was essential before the Tornado could release its bombs.

For the Buccaneer navs, locating and identifying the targets on the designation pods could be very difficult. First, the Pavespike pod was not linked to the aircraft's nav/attack system so there was no computerised or inertially aided means of slewing the pod onto the target. The work around for this was that, shortly after getting airborne, the aircraft would be accelerated to attack speed and, from a line astern position, the crew would boresight the pod against one of their accompanying aircraft, the pilot making a mark on his sight with a chinagraph pen to align with the navigator's Pavespike pod sight – I will come back to this shortly. Secondly, the limitations imposed by the Buccaneer's navigation kit meant that simply finding a target in barren, often featureless terrain, was an issue in itself. Indeed, prior to the target run we dared not lose visual contact with our Tornados, as finding the formation again was not easy and clearly the integrity of the formation was vital to the whole process. This often meant flying in close formation, in cloud, as a four- or six-aircraft package for two hours or more.

At around 10 to 15 minutes from the target the four Tornados would split into pairs in order to provide the required over target spacing, individual Buccaneers remaining with their respective

Tornados, flying a wide visual ‘battle formation’ at heights between 22,000 and 27,000ft, always flying slightly above the Tornados – it had not escaped our notice that putting the Tornados between ourselves and the ground-to-air threats increased our chances of survival, the Tornados effectively acting as active decoys! About 20 miles short of the target the leader of each Tornado pair transmitted a codeword, which was the cue for its accompanying Buccaneer to split and accelerate ahead in order to acquire the target. The Buccaneer pilot then had 45 to 60 seconds to acquire the target visually, place his boresighted chinagraph mark over it – which meant entering a dive of around 5º, depending on distance from target, and hold the mark on it until the navigator had identified the target or target area and had started tracking it on his screen. Coping with the obscurity caused by desert haze and dust, coupled with slant angle, was a constant problem.

Once satisfied that he had the target, a codeword was broadcast from the Buccaneer’s back cockpit to let the Tornados know that they were clear to release their 1,000lb Paveway II LGBs, usually in sticks or salvoes of either two or three. Once the navigator was tracking the target, the Buccaneer pilot was free to manoeuvre the aircraft but only within clearly defined parameters, because the pod, which was carried on the left hand inner wing pylon, suffered from both airframe masking (getting a part of the aeroplane between the target and the Pavespike’s sighting head) and gimbal limits. Although you could certainly pull out of the initial dive and ease away from threats in the target area and from other aircraft in the formation, if the Pavespike’s gimble-mounted electro-optical sighting head hit its stops, it would automatically ‘cage’, which is to say that it would boresight back to dead ahead.

With bombs already in the air, the only way to re-acquire the target and resume laser designation would be to go through the whole process again but, now being much closer to the target, this would involve a much steeper dive – and it was most unlikely that this could be achieved in the time that remained before the bombs impacted. I should perhaps stress, incidentally, that the optical magnification of the pod inevitably resulted in a very narrow field of view, so the navigator was effectively ‘looking through a drinking straw’ while trying to identify the target which he then had to track continuously

Hardened aircraft shelters, each one individually targeted and surgically destroyed by an LGB

using a thumbwheel with his left hand. It was a delicate task, not eased by the fact that there was a slight lag between operating the thumbwheel and the pod's response. All this while having to contend with the aircraft manoeuvring, and reacting to ground-to-air threats. Since the only RWR display, and the majority of the controls for the AN/ALE-40 chaff and flare dispensers, were in the rear cockpit, this served only to increase the load being carried by the already stretched navigator..

These attacks were real team efforts – a lot had to happen both in and out of the cockpit and it could be a tense time.

Our early sorties were flown, in the main, against interdiction targets, broadly intended to disrupt the movement of Iraqi forces – bridges, and petrol, oil and lubricant production and storage facilities. However, from 12 February the mission largely changed from interdiction to offensive counter-air, primarily aircraft in hardened aircraft shelters, expanding from around 15 February, to embrace airfield targets in general, such as runways, taxiways, PBFs (Pilot Briefing Facilities) and hardened bunkers.

From 21 February the standard load for a Buccaneer was, from left to right, an ALQ-101 ECM pod, an LGB, the Pavespike pod and a second LGB.

Until 20 February the Buccaneers were flown only on co-operative designation missions. For these sorties the aircraft carried a Pavespike pod on the left inner wing pylon, an AN/ALQ-101 ECM pod on the right inner pylon and an AIM-9L Sidewinder on the left-hand outer. Chaff and flares were also carried as a standard fit and an internal fuel tank was fitted in the bomb-bay. However, from 21 February the opportunity was taken to arm the Buccaneers with Paveway II LGBs on the right-hand inner and left-hand outboard pylons, the Sidewinder having now been removed as, by that stage, the Iraqi Air Force was no longer considered to represent a credible threat.

A quick change to tactics and procedures followed and the Buccaneers, having first designated for the Tornados as before, would now remain over the target area as a pair and execute high-angle self-designation dive attacks, tipping in from around 27-29,000 ft to drop their own LGBs – a high-angle, ie 45º-55º, dive being the only way to get the Pavespike sight on the target while at the same time being close enough to the target to ensure that the release point would be within the weapon seeker's field-of-view, bearing in mind the Buccaneer's lack of accurate navigation capability which, in turn, precluded any form of level weapons delivery, the intricacies of which are beyond the scope of this paper.

It did not escape our attention that these self-designation attacks meant that the RAF's Buccaneers had, in their final years of service,

actually delivered live munitions in anger – albeit perhaps not in the way its designers at Brough had envisaged, but a success nonetheless.

It would, however, be quite wrong to suggest that it was easy, or that we had had it all our own way. We were lucky in many respects; there were undoubtedly flaws in our tactics and it could be argued that we also became complacent. As I have already mentioned, my first combat mission was against Al Taqaddum airfield where we had lost an aircraft earlier that day. The loss of that Tornado was a harsh reminder that operating at medium-level was not a panacea and that, although very much on the back foot by this stage, the enemy always has a vote. That Tornado had been the eighth aircraft in an eight-ship formation and one did wonder whether there might not have been a cleverer way of going back in to hit that same target again. That thought was in the back of my mind as we were about to repeat exactly the same tactic – and we were going to be the last aircraft through from our formation. Sure enough, as we attacked, from the same direction and using the same profile, we were engaged by SA-3 and SA-6 surface-to-air systems. Furthermore, later in the campaign we were routinely loitering above our targets, executing our self-designation attacks for up to six minutes from first co-operative weapon impact to last self-designation impact. I vividly recall, as Number Six in a formation, pulling out of more than one such high-angle delivery through a hail of well-aimed AAA. For us to have assumed that the enemy would not have been able to visually acquire us and optimise their weapon solutions within six minutes was somewhat reckless.

By the end of the campaign, our twelve Buccaneers and eighteen crews had flown some 226 missions. Thankfully there had been no losses, and on 17 March all twelve aircraft took off from Muharraq for the nine-hour non-stop return flight home, accompanied by Victor tankers. So ended the Buccaneer's first and only war during its years of RAF service. Ironically, it had not been flying in the low level maritime strike role for which the aircraft had been designed, nor on low level overland strike/attack missions into Eastern Europe for which it had been adapted, but at medium level in the Middle East.

The Buccaneer's performance on Op GRANBY is a reminder that, regardless of its age, it is the quality and flexibility of an aircraft and its equipment, and of the people who fly and maintain them, that

The Buccaneer had proved itself in 1991 but within three years the last of them had been withdrawn from service.

determines a weapon system's capability and thus its effect, whether at the tactical, operational or strategic level. Participation in Operation GRANBY was a challenge for the Buccaneer but it must be acknowledged that, while it was an old platform, it was its unique ability to deliver smart precision weapons that determined its utility. This was a game-changer and in many ways is the wider point.

For the aircraft itself, when called it stood up to the plate, eloquently captured by Wg Cdr Bill Cope, the Commander of the Buccaneer Detachment at Muharraq, who, when asked by the media to comment on the effectiveness of an aircraft that had already seen some three decades of service and was fast approaching retirement, said, 'My old grandmother is getting on a bit, but you wouldn't want to mess with her.'

As for me, I had succeeded and survived – I wanted no more.

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TANKER SUPPORT TO ALLIED OFFENSIVE OPERATIONS

Air Cdre Geoff Simpson

Air Cdre Simpson graduated from Cranwell in 1970. His early career included flying Vulcans with Nos 50 and 35 Sqns and ADC and PSO appointments. Following a tour at HQ SAC, he became OC 101 Sqn and commanded the RAF Detachment at King Khalid International during Gulf War I. Subsequent appointments included tours: at SHAPE; in command of RAF Waddington; as SASO 38 Gp and, finally, as Air Attaché in Washington. Since retirement from the RAF, he has been a consultant for Burdeshaw Associates, worked with several Service Charities and is currently Chairman of the largest and most active wine appreciation society in the UK.

Let us begin at the end. Tanker operations in support of Op GRANBY were concluded on 13 March 1991, precisely 22 years ago today, with the return from theatre of all nine VC10K tankers of No 101 Sqn, having earlier cast off the last of the returning Tornado GR1s and Jaguars, to their respective home bases.

I was, at first, a little surprised to find the RAF Historical Society had chosen Op GRANBY as the subject of a seminar – 22 years on from the event. I thought that everything that could have been said, had since been said, in the course of the endless analysis and the plethora of articles published in the written media, in the months following the Gulf War. And I truly believed the fundamental importance of air-to-air refuelling, to the successful prosecution of allied offensive operations in the first Gulf War, was a message that had been fully grasped and understood. That was until, in my research for today, I chanced upon DDefS's four-page Gulf War Retrospective in the 1992 *RAF Yearbook* which, interestingly, mentions AAR just once and then only in a short list of other 'combat support' assets.

That said, I looked forward to this opportunity to review my personal conclusions, lessons learned and recommendations of the time, as set out at the Air Power Symposium, held shortly after the conflict at RAF Cranwell. So, given the passage of time, and armed

with my log book, some helpful stats from the AHB and a fading memory, I do hope that you will forgive me for basing my rather No 101 Sqn-centric presentation, largely upon personal recollection and reflection.

Tanker operations in support of Op GRANBY commenced in the early hours of 9 August 1990, less than 12 hours after the Cabinet decision to deploy British forces to the Gulf in support of UN Security Council Resolution 660, with the departure for Akrotiri of a VC10K holding TANSOR standby at Lyneham. Soon afterwards, two further VC10Ks joined the first aircraft in Cyprus from Palermo – where they had been carrying out what was to prove the longest night-stop in aviation history.

Of course, at that time, the RAF's tanker force was largely considered to be an Air Defence asset. Indeed, it was while holding TANSOR alert – ie tanker support of air defence aircraft on standby to intercept the Soviet/Russian bombers which routinely tested the UK's readiness by flying down to the North Sea and the UKADR – that the first aircraft was tasked to fly to Akrotiri, to prepare for further deployments following Saddam Hussein's invasion of Kuwait.

Over the next 24 hours, three additional VC10Ks were diverted to Cyprus ready for the deployment of a squadron of Tornado F3s to Dhahran. This was accomplished on 11 August, with the tankers returning to Akrotiri, having cast off their chicks near Luxor in Egypt. Two days later, on 13 August, the initial deployment was finally completed by the trailing of twelve Jaguars into Thumrait, in southern Oman, where they set up operations along with two VC10Ks for tanker support. From a standing start, twenty-four fast jets had successfully been deployed into theatre within 96 hours.

The next 72 hours saw production of the first offensive plan for inclusion in the Theatre Air Tasking Order, and we were placed on one-hour standby for ops. Thumrait was a remote SOAF Jaguar base with virtually no support facilities for large jets, and I clearly recall being met by the local Base Commander, who could not get over the fact that, just four days since it had all kicked off, the RAF had already managed to desert-camouflage its tankers. However, I was not of a mind to disillusion him by explaining that our VC10K tankers had always sported the 'hemp' colour scheme originally selected for use by the maritime Nimrods over the murky waters surrounding the UK.

An LGB-armed Tornado taking on fuel from a VC10.

For the rest of August, the two VC10s trained every day with the Jaguars in the southern desert. But while Thumrait suited the Jaguars, as they could work up alongside their Omani sister squadron, enjoying common facilities and an excellent training environment, from a tanker perspective, the location was far from ideal – not least because the base was so far from the action.

In addition to a general lack of appreciation of the problems of large aircraft operations by our hosts, we were desperately short of suitable ground support equipment, pan space and fuel reserves. Moreover, extreme temperatures (50ºC was not uncommon) and the high winds and sandstorms associated with the monsoon, made bare-base operations very difficult. Nevertheless, our hosts provided every possible assistance, and this, together with a bit of logistic support from a small USAF detachment – and No 101 Sqn's familiarity with autonomous operations – saw us through a difficult three weeks.

So it was with some relief, albeit after several false starts, that the two Thumrait aircraft eventually found a new home at Seeb, outside Muscat, a much more hospitable operating base, but still far too

F/A-18s taking on fuel from a VC10, the tanker of choice for the USN.

remote to support the anticipated offensive operations into Iraq. A further two VC10Ks were, in the interim, positioned at Bahrain in support of the further deployment of Tornado GR1s.

I should perhaps offer some basic thoughts on AAR doctrine. Clearly, the key to effective tanker support is getting and maintaining the required amount of fuel in the air where and when it is needed by the receiver aircraft in order to complete all phases of their mission. But, as well as tanker capacity and configuration, another, perhaps even more important, factor in the 'fuel in the air' equation is the minimisation of fuel burn, particularly by the tankers themselves. This latter imperative requires the tankers to be based as close to the planned receiver brackets as possible, to minimise the fuel burned in transit and also tanker-to-tanker transfers, so that the minimum number of aircraft – and hence turning and burning jet engines – are in the air at any one time and thus using precious fuel. It was to prove particularly challenging to achieve this within the parameters set by the Air Tasking Order – more of which later.

So far as our basing was concerned, Seeb was handily placed to support the work-up of the USS *Independence* and its air group in the Gulf and the VC10K, with its multiple hoses, was their tanker of choice. But the extra hour of transit to and from the northern Saudi training areas, necessitated by the UAE's reluctance to permit tanker overflights, seriously hampered our ability to support training in Northern Saudi and Bahraini airspace. The result was many weeks of penny-packaging of a limited number of tankers, with assets split

Receiver's eye view of a VC10.

between Seeb, Bahrain and the UK, and I regularly found myself on the wrong side of the staffs in the UK and at Riyadh, in my efforts to get more tankers brought forward into theatre.

Again, the requirements peculiar to operating large aircraft at intensive rates did not appear to be fully understood by the staffs and we suffered greatly from a lack of redundancy and economy of scale, as well as the recurring problems of fuel availability, ground support equipment and pan space. Moreover, it was a common misconception that very high flying rates were unsustainable, and that there was a direct relationship between sortie rate and spares consumption. In reality our actual spares requirement, at 300% of peacetime authorised flying task, was no higher than for 100%, proving, yet again, that with airliners (as with many other types – and most pilots) the more you fly them the more they like it!

During September and October, the tanker detachments settled down to a continuous pattern of intensive operational work-up training with the Tornado GR1s and Jaguars in the Omani training areas, and the Tornado F3s on their Northern Saudi combat air patrols. The experience previously gained from regular participation in international exercises such as RED FLAG and IADS proved absolutely invaluable during the operational work-up phase of Op GRANBY. We experienced little difficulty in adjusting to the complex procedural environment in the Gulf and our peacetime training proved to have been totally appropriate to the task at hand.

However, a lack of AAR experience, particularly on the part of many of the Tornado crews being drawn from RAF Germany, placed a great strain on the remaining UK-based tankers, at the worst possible time, and also took its toll on the stock of baskets. Moreover, once in theatre, this inexperience of tanker operations led to attempts to depart

from the established – and well-tested – SOPs which jeopardised our ability to conduct wholly silent procedures and, occasionally, generated friction among units, unaware of *ad hoc* arrangements made by others. Indeed, the utilisation of tanker assets throughout the training work-up period proved to be less than ideal and on numerous occasions one tanker could have done the work of two, had more forethought been given to co-ordination of tasks.

This was to remain a recurring theme, even throughout the period of hostilities and it is my view that the level of AAR representation on the staff of the Air HQ was too low, effectively consisting of no more than a two-man mission planning cell. It was, therefore, difficult to convince the customers that greater co-ordination and a rationalisation of AAR assets would be of benefit to all concerned.

Operational training continued unabated for the remainder of the year, including work with the USN's EA-6Bs, which was to prove a boon during the subsequent hostilities. However, an attempt to obtain clearance for the VC10K to receive fuel from USAF KC-10s was turned down by Strategic Air Command.

When the RAF established a Tornado detachment at Tabuk in October 1990, it shifted the focus of tanker support much further west into Saudi Arabia, which left the tankers at Seeb even more remote from the theatre of operations. Fortunately, the temporary eviction of No 101 Sqn from Seeb during the Omani National Day celebrations provided an ideal opportunity to explore a new location at King Khalid International Airport (KKI), some 25km north of Riyadh. This was to become the VC10K main base for the conduct of wartime AAR ops.

The move was accomplished on 16 December when, what had become something of a nomadic outfit, launched its last operational training sorties from Seeb, Bahrain, Riyadh and Tabuk, to land at King Khalid. At this point a detachment of No 55 Sqn's Victor tankers was deployed into Bahrain, where they took over No 101 Sqn's facilities and quickly completed their work-up phase.

As much of the ground equipment had to be left behind in Bahrain for use by the Victors, and in Seeb for the Nimrods, the VC10K Detachment again found itself without proper ground support, a situation which was to prevail until the commencement of hostilities in mid-January. Together with the perennial problems of lack of space

A Victor accompanied by a Tornado and a Buccaneer.

and fuel provision, in terms of engineering facilities, No 101Sqn was right back to square one.

Nevertheless, despite the problems, in the three months or so running up to commencement of the air offensive, some 600 work-up sorties – involving a fuel off-load of 14,000 tonnes – had been successfully completed by the various elements of the Tanker Force.

In war there is a fine balance to be struck between surprise and communication However, the element of surprise was total on the evening of 16 January, when the Riyadh detachment found out *by accident* that the war was about to begin! Lacking a dedicated communication centre, I was unable to receive the message relaying the 'execute' and, consequently, this was not received until shortly before first launch. So, as the crews had not been able to in-brief on the early sorties because of the need for absolute secrecy – and we had inadvertently been given only the *second* day's ATO – final preparations were unacceptably delayed. Indeed, initial confirmation of war was only provided by a young USAF maintenance captain who came to seek spare fuel pits for his first sixty-three sorties, which were to be recovered in the early hours of the following morning!

This chain of events could well have had a disastrous effect on the first night's operations and, as it was, tankers were put at unnecessary risk by having to cut across conflicting tracks to make good the set RV times. Nevertheless, the aircrews did an outstanding job in meeting the task and, having weathered the early storm, the ATO system subsequently appeared to work well – albeit at the expense of some flexibility and the ability to make last minute changes to the plan.

The largest of the RAF's tankers, the TriStar's endurance and capacity made it ideal for supporting fighters maintaining combat air patrols – in this case F/A-18s.

As time passed, the crews' planning for the AAR support packages also became over-complicated by various units adopting different RV positions and times, thereby increasing the potential for a much-feared mid-air collision as 'reading between the lines' of the ATO became necessary for the delivery of AAR support. Moreover, conflicting mixed tanker packages were programmed and, on one occasion, five agencies from three different bases were tasked to contribute to a package of some thirty aircraft in the same limited airspace in bad weather.

Obviously, the absolute priority for the tanker crews was to meet the immediate needs of the offensive aircraft and formations, and this very soon led to a few forays into unknown territory, between the lines of the ATO, in order to generate the maximum fuel airborne – or to deliver fuel to receivers who, for whatever reason, had had to deviate from the ATO routings.

An early difficulty was encountered in refuelling the JP233-equipped Tornado crews who, given the size and weight of their externally carried ordnance, had to refuel at relatively low levels between 10,000 and 14,000ft where the cloud and turbulence was regularly at its least conducive. Nevertheless, as the air battle progressed, I am pleased to say that the tanker planning process improved immeasurably, thereby reducing the potential for a mid-air

An EA-6B taking on fuel from a VC10.

incident.

The tanker force continued to support both trails and towlines throughout the air campaign and, despite its single hose, the TriStar K1 of No 216 Sqn provided a welcome addition to the force, with its huge fuel uplift and its ability to support combat air patrols for extended periods of up to 8 hours. The TriStar was ideal for that role and saved a considerable number of VC10 and Victor sorties.

From the AAR standpoint there can be no doubt that the operation was a complete success. As well as supporting our own air defence, attack, recce, maritime and air transport forces, we also demonstrated the value of interoperability with our NATO allies and the Saudi Air Force. Our most regular customers were the F-14s and EA-6Bs from the Red Sea fleet, which were collected in the western desert and injected into central Iraq to provide SEAD –suppression of enemy air defences – for our Tornados. A similar service was also provided in the east to French Mirages, Canadian F-18s and Saudi ADV Tornados. Indeed, it was not uncommon to refuel aircraft of three or four nations concurrently, with, on one notable occasion, a tanker supporting British, French, Canadian and Saudi receivers, all controlled by US AWACS.

Finally, some numbers highlighting the major contribution of the

UK tanker force to the prosecution of the air war: At least 90% of all RAF attack and air defence sorties were AAR dependent. Close to 3,000 receivers were refuelled during hostilities, of which a quarter were of other nationalities. From an in-theatre tanker force of just seventeen aircraft, 750 sorties were flown without loss and with a mere handful of air aborts. This represented the sustained achievement of more than 300% of the peacetime authorised flying task, the VC10K actually achieving more than 350%. Refuelling was carried out at all levels from 1,000ft to more than 40,000ft, and in some of the worst weather one could imagine.

So, in closing, forgive me if I reiterate my principal recommendations to the Air Power Symposium which followed the Gulf War:

- First I contended, and still contend, that AAR is not a force multiplier; it is a force enabler – after all, at least 90% of all RAF sorties were AAR dependent.
- Furthermore, I believed that, to get the best out of our limited tanker assets, we needed proper representation, at all levels, and much closer identification with one or both of the offensive and defensive roles which the tanker force primarily serves.
- And finally, I asserted that AAR was an entity in itself and that the role did not sit easily with Air Transport, with which it had always been twinned for reason of commonality of aircraft types.

Clearly, this was a long-lost cry in the wilderness, as the Voyager is currently being introduced as a transport asset, in No 2 Group – with a capability gap, to boot!

SUPPORT HELICOPTERS AND THE GROUND WAR

Gp Capt Mike Trace

Commissioned into the Engineer Branch in 1969, Mike Trace spent his first tour working on the Lightning at Leconfield before training as a helicopter pilot. He subsequently flew the Puma with Nos 33 and 230 Sqns, in Northern Ireland, Germany, Belize and Saudi Arabia. Ground appointments included stints with the Army HQ in Ulster, on the staff of HQ RAFG and at MOD, command of RAF St Mawgan and three tours with the Personnel Management Centre at Innsworth. Since retirement in 2001 he has acted as an Expert Witness, advising the legal profession on the peculiarities of military life, and been Vice-Chairman (Air) for the Wessex Reserve Forces' and Cadets' Association.

At the end of a day when we have examined in depth the details of the Operation GRANBY air campaign, it is perhaps appropriate that, for this last session, we turn our attention to what was happening on the ground, or closer to it at least.

The ground war did not last anywhere near as long as the air campaign – it was all over in just one hundred hours. Nevertheless, it was still a major, multi-national undertaking. In almost total secrecy, the start line was translated some two hundred and fifty miles to the NW, then the attack was launched across another two hundred miles of open desert through Iraq and into Kuwait by the back-door. The First British Armoured Division alone comprised some twenty-five thousand personnel, and sixteen hundred fighting vehicles plus many more in support. Add to that four other divisions to make up VII (US) Corps; another complete American Corps attacking deeper into Iraq; and a host of Arab allies and US Marines operating along the coastal strip. That might give you a better idea of the overall size and scale of the ground campaign. But that is not how it began.

First on the ground was the United States Marine Expeditionary Force. Their initial task was to deter Iraq from entering Saudi Arabia. The 7th Armoured Brigade from Fallingbostel in Germany was

nominated as the British contingent, and it was Brigadier Patrick Cordingley who requested RAF Support Helicopters (SH), purely for the evacuation of British casualties. That rôle fell naturally to the Pumas in Germany and, whilst Casevac had always been a secondary rôle, this was the first time that it would be our primary task.

The pause between the Iraqi invasion and our eventual arrival in Saudi Arabia three months later might appear unduly delayed. After all, SH had always claimed to be mobile and available at very short notice. But the fact was that the rotary force had been allowed to slip a long way behind in terms of avionics. The Puma had only the basic IFF, no secure radio, no electronic warfare equipment and a navigation system dependent upon obsolescing ground radio beacons. Whilst some protection against missile attack could be bolted onto the airframes, it soon became very apparent, that the survival in the American-driven airspace control régime required the provision of Have Quick radios and Mode Four IFF. Have Quick required an accurate electronic time signal. This could most easily be provided by GPS, which, fortuitously, also solved the navigation problem. Looking back, I am quite convinced that we could not have operated effectively and without major incident in the way that we did, had the aircraft not been fitted with GPS.

There was, then, a huge programme of modification which had to be completed before we could take up our new-found duties in the desert. In addition, there was much personal training needed: enhanced NBC drills, both on the ground and in flight, and fighter evasion, to name but a few. There was also an unusual clamour for individual live firing practice, mainly because the SA80 rifle had only just been issued. All this training had by no means been completed before we deployed. Much of the avionics had to be fitted in-theatre; some arrived only days before the ground war began. So aircrew familiarisation necessarily continued up to the very last minute.

The helicopter requirement had also increased and now incorporated the whole of my squadron, No 230 Sqn from RAF Gütersloh, plus half of the only other Puma squadron, No 33 Sqn based at RAF Odiham. All the intelligence information before we left strongly suggested that we would be at war within weeks; the pressure was certainly on.

So on or around Guy Fawke's night, two parties of SH personnel,

A Puma in the desert. Just discernible are the shiny leading edges on some of the tail rotor blades – bare metal where the protective tape has been removed by sand.

aircraft and vehicles were flown and shipped out to Saudi Arabia. The destination was Al Jubail, an oil terminal on the Gulf coast, between Kuwait and Bahrain. That was where the US Marine Expeditionary Force was based and where 7th Armoured Brigade had disembarked a few weeks before.

Jubail International airfield was crammed full of American troops, fixed-wing transport, off-loaded stores, burger bars and Dunkin Donuts. The only other airfield nearby, a Saudi Naval Air Base, had been taken over by fixed-winged aircraft of the US Marine Corps. Instead, the US Marines suggested we could operate alongside their helicopters at Ras-al-Ghar, a Saudi Naval SEAL compound on the coast further south.

This gave us an element of security inside a patrolled chain-link fence, but we could neither dig trenches nor pitch tents on the hardened surface. At least we had Portakabins and copious sand for bagging. We were also able to keep most of our equipment packed on the vehicles for rapid deployment. Domestic accommodation was found on the edge of Jubail in a Rezeyat[1] compound, built for immigrant oil-workers. This was a dozen miles or so away by road, hardly a sensible way to go to war, but Jubail was never intended to be more than our main base, with independent flights operating closer to the scene of the action.

From the start, we decided to fly tactical pairs of aircraft, each with constituted crews: two pilots, to share cockpit workload in a high threat environment, a crewman and a medic from No 1 Field

A Chinook creating its own sandstorm, an inevitable consequence of desert operations.

Ambulance Regiment. These soldiers were mostly privates, few of whom had ever flown, but they amazed us by rapidly learning how to call airborne threats using the clock code, whilst looking sideways out of the cabin windows of a manœuvring helicopter. The four-man crew had considerable equipment to be taken on each flight: emergency water supplies and personal survival kits; full aircrew and ground respirators plus six individual NBC suits; weapons, ammunition, escape maps and so on. When aircraft were dispersed and in temperatures of +40° Celsius, locally supplied pick-up trucks became essential just to get everyone and everything to the helicopter.

The very fine sand of the Saudi desert caused considerable damage to both engines and rotor blades. Main blades and tail rotor blades were being abraded faster than anyone expected, and the protective tape applied to leading edges had to be replaced frequently, especially if landings had been made onto unprepared sand. More surprising, was the apparent failure of the polyvalent intakes for the engines. These had been designed for the French Army's operations in Chad, but sand was still getting into our engines and wearing down the compressor blades. Engine life, normally 400 flying hours, was often reduced to 40. At one stage before the war started, every spare Puma engine available to the Ministry of Defence was in Saudi Arabia with me. Nor was that the only difficulty. The dust cloud blown up during the approach often obscured the landing point; at night this became treacherous. Revised approach techniques had to be practised, and pre-planned landing sites sprayed with crude oil in an attempt to keep loose sand down to a minimum. The problems with sand were never completely solved.

Wg Cdr Trace and Brig Cordingley making sure that Sir Harry Secombe is safely stowed aboard his helicopter.

Airspace co-ordination was complex. A network of turning points was established across the whole area, to be linked up by random routes which would change at 6-hourly intervals. Whilst this was much like the SUPPLAN MIKE[2] that we had been used to during the Cold War, the turning points were more obscure in a flat, featureless desert. Even major cross-roads could be covered by drifting sand and become invisible from the air. Then the co-ordination level between fixed-wing and helicopters was set at 250 ft above ground level day and night. That meant that all our flying would have to be below 200 ft, ideally very much lower. Whilst skies were generally clear and the desert had few vertical obstructions, problems were magnified on night vision goggles. Worse still, the final assault would inevitably be planned for when there was no moonlight.

There were lighter moments. Sir Harry Secombe was determined to make people smile when he visited. It started, unintentionally, the moment he arrived by Puma, when he missed the cabin step and fell onto concrete underneath the aircraft. Here was a 70 year-old lying flat on his back, but as I crouched down in trepidation, I found him giggling. Throughout his visit his laughter was infectious; it set everyone around him laughing. But the Brigadier and I were very serious putting him back on the helicopter.

It was only at Christmas that we in Jubail became aware of a major revision to operational plans. The British would no longer fight up the coast in support of the Marine Corps. The Marines were disappointed, because they really valued our heavy battle tanks, but it is safe to say there were few regrets on the British side. Re-invasion along the coast was the route most obvious to both allies and enemy, and would certainly have involved heavy casualties. Instead, the brigade was to be expanded to a full Armoured Division, we would be joined by a

dozen Chinooks and more naval Sea Kings, and the whole British ground component would be re-subordinated under VII (US) Corps.

Seven Corps were in the process of deploying to the area of Hafir-al-Batin, from where the main allied assault would be launched, through Iraq and into Kuwait from the west. There was only one single carriageway for redeployment; it was called the tap-line road because of the oil pipeline which ran its full length alongside. This massed movement along a single route was vulnerable to physical attack but, more importantly, it had to be conducted under conditions of absolute operational security. The strategic surprise of the planned attack was paramount.

The logistic resupply of the 1st British Armoured Division was a task way beyond the capability of the Chinooks, but they would prove invaluable for urgently needed items, particularly over such a distance. Towards the end of January, they began moving supplies to Logistic Base Alpha, which they made their main operating base shortly thereafter.

The new main operating base for both Pumas and naval Sea Kings was within King Khalid Military City (KKMC), an enormous fenced off area of desert about the size of Hampshire. On one side of us, beyond the RN Sea Kings, was an American Patriot battery; on the other an American field hospital equipped with two complete body scanners which, at that time, would have been the envy of many a National Health Service hospital. The Casevac task was now to be split: the Sea Kings would fly the rear loop back to Jubail, as they had greater endurance; the Pumas would fly the shorter forward loop between field dressing stations and the field hospital near to KKMC.

The helicopters were now dispersed over a wide area, with a protective sand bank or ‘berm’ bulldozed around the whole site, including our tented accommodation. The intention was still to have a forward flight, but the bare desert and absence of anything offering concealment drove us towards the concept of one mobile, but well-defended, forward base. For major servicing or repairs, the aircraft could be brought back to KKMC, even if a little help from the Chinooks was needed at times!

Then one day, just before the ground war began, all those on the main Puma base in KKMC were stunned by a sudden, enormous explosion, which sounded very close, followed by the sound of bits of

US soldiers recovering bits of the Patriot missiles that had created some excitement at KKMC.

metal raining down upon the camp. After emergency gas drills and checks on the chemical detectors, the all clear was sounded and we ventured outside to check. We were soon joined by US Army personnel intent on collecting every last piece of Patriot missile they could find at our site. It would appear that two missiles, launched against the same target, had collided above us. Remarkably, not one of the helicopters was damaged by falling debris.

The border between Saudi Arabia and Iraq was marked by a series of sand berms, with intervening barbed wire, obstructions and ditches which would probably be flooded with crude oil and set on fire. The minefields were thought to be extensive and the troops well dug-in. Specialist American vehicles would make the initial, narrow breach, through which huge numbers of fighting vehicles had to pass unimpeded, before the armoured divisions could form up in fighting order on the other side.

After all the meticulous planning, the actual breach before dawn on 24 February was an anti-climax. The ditches were not set alight; the minefields were not as large as expected, and the enemy troops were scattered in small groups and apparently devoid of officers. The

A Chinook-load of PoWs being flown to Hafir-al-Batin.

progress of all four divisions of VII Corps in line abreast was faster than anyone had expected, and plans were hurriedly brought forward in order to maintain momentum. Scarce was there time for tanks to refuel and re-arm. Mercifully, there were few allied casualties, but a new and more pressing task then loomed.

Forward ground units became bogged down by prisoners of war, who were giving themselves up in enormous numbers. To maintain progress, PoWs had to be collected, allowing their temporary guards to get back to the fight. A PoW compound was hastily established near Hafir-al-Batin, and Pumas and Chinooks flew to full capacity day and night to recover them from where they had surrendered. Eventually, the British collected 7,024 prisoners of war, the vast majority of whom had been flown into Hafir-al-Batin by helicopter.

Bad weather precluded all helicopter flying on the first night, and subsequent nights were only marginally better. One night will abide in the memory of many of the crews who were airborne. In the midst of a long, multi-aircraft transit in the small hours, several thunderstorms erupted. In pouring rain, with lightning flashes all around, the goggles barely coped, but the crews did and all aircraft returned safely.

Burning oil wells; this picture was taken in daylight.

Nor was visibility any better in daylight, for by now the oil wells right across Kuwait were alight and plumes of choking, dense black smoke were everywhere. There seemed to be no gaps between them. Thankfully, this was the day that President Bush announced the ceasefire.

The day after, 1 March, I was tasked to meet a New Zealand Hercules at Kuwait International Airport and fly General de la Billière around the divisional area to congratulate the British troops. His final call was to the newly reinstalled British Ambassador to Kuwait. The Embassy had only been recaptured the previous day by UK Special Forces, entering through the roof for fear of booby traps. Two Pumas parked on the football pitch outside the Embassy rapidly attracted crowds of locals celebrating liberation. Whilst families congregated around the aircraft, Kuwaiti men drove round and round firing guns vertically into the air. I remember wondering where all those bullets would land.

On our way back to the airport, we showed the General the devastation around the road leading back towards Basra. Fleeing Iraqis had taken every vehicle they could find in their panic to get home. When allied ground attack aircraft had blocked one carriage-

way with wrecked vehicles, the escapees used the other. When that was blocked they drove on the hard desert, but there was no way home. As we flew over, Kuwaitis were beginning to go through the vehicles. This was not so much looting, rather they were recovering equipment stolen from them in previous days.

Whilst they were waiting for General de la Billière to return, the New Zealand aircrew had grabbed a multi-barrel, ground artillery piece as booty, and it was chained down on the Hercules ramp. The General had entered by the forward cabin door, so it was only when they were airborne that he spotted the gun. Apparently, the Kiwis went white when he asked if they had checked it for booby traps.

We slept on the Embassy floor that night, but before turning in went for a walk in Kuwait city. I vividly remember that there was not a single electric light in the city, and we saw journalists in the best hotel cooking themselves a meal on hexamine stoves. The decorative brick work in the pavements all along the waterfront had been ripped up and used to build a defensive wall along the shore, which even incorporated pillboxes. Inside were hundreds of RPG7 rounds.

Every Iraqi tank we had flown over that day had been dug in and individually protected by a sand berm. They were totally unable to manœuvre and were all facing south, the direction from which they had expected our attack to come. Nearly all of them had been hit with armour piercing rounds fired from the west. That we achieved total strategic surprise on the ground is due entirely to the intensity of the air war and the removal of Iraqi eyes and ears. And whilst the actual liberation of Kuwait could only have been effected by ground forces, none of the ground commanders I knew would deny that it could not have been done so quickly and with so few allied casualties, had it not been for the Air Campaign.

Notes:

[1] The Rezayat Group is a large, and expanding, business enterprise, with its headquarters in Saudi Arabia but providing a wide variety of services and facilities across the Middle East and elsewhere.

[2] In the event of war, COMAAFCE's SUPPLAN MIKE would have provided a network of predetermined low-flying routes in the Central Front region, aircraft adhering to these tracks were assumed to be friendly, those not doing so were liable to be engaged.

AFTERNOON DISCUSSION

Peter Symes. The potential impact of the *Scud* attacks on Israel were a great cause for concern. Can the panel comment on the political value and the military effectiveness of the RAF's *Scud* hunting.

Air Chf Mshl Sir Patrick Hine. The big worry was not the physical damage that the *Scud*s might cause so much as the political damage they might inflict on the solidarity of the Coalition. Saddam's attacks were a deliberate attempt to provoke Israel into responding militarily with the aim of inciting a 'jihad' (holy war) that would cause a break-up of the coalition. Fortunately, the American Administration were able to dissuade the Israeli Government from taking any offensive action against Saddam. 'Leave it to us' they said. The Israelis did, and the US in turn rushed Patriot missile batteries to Israel to help contain the *Scud* threat.

So far as anti-*Scud* operations were concerned, we were very successful at neutralising the fixed sites. We knew where they were and we took them out in the early stages of the air campaign. We were far less successful at countering the mobile *Scud*s and there were quite a lot of these in Western Iraq. We used Special Forces as well as air power in our efforts to locate and destroy them but I do not think that we can claim more than very limited success.

Air Chf Mshl Sir William Wratten. We had LGB kits in-theatre from the outset, but when I sought General Horner's permission to bring out some Buccaneers – this was actually before the war had begun – we were reassured that his F-15s would be able to provide all the laser designation that we would need. What he didn't want, of course, was yet another different type of aircraft in-theatre, with all of its associated support elements. The available airfields were already overcrowded, particularly Bahrain, and the Saudi Base Commanders were becoming increasingly leery about accepting more aircraft.

In the event air supremacy was established very rapidly, so the Tornados moved up from low-level to medium level, anticipating the promised designation support. Unfortunately, that didn't materialise because the political implications of the *Scud*s meant that Horner had no alternative but to do his best to neutralise the threat that they represented – and that meant that his F-15s were fully committed. So

that was why there was an hiatus between the JP233 phase and the start of *effective* medium level bombing – and it was that which limited the RAF's ability to contribute to the anti-*Scud* effort.

Hine. The USAF didn't have all that many laser designating aircraft themselves. Some of the F-16s and, I believe, one of the F-15E squadrons, perhaps about 30 aircraft in all. So it was always going to be a scarce resource.

We had first begun to worry about having a viable alternative to Tornado GR1 low-level attacks with JP233 back in October 1990. We had done no medium-level bombing in either Strike Command or RAF Germany for years, so it was clear that the only way we could be effective would be by using the Paveway/Pavespike option. As you have heard, we deployed 1,000 pound bombs with LGB kits but their use was entirely dependent on the Buccaneer which was then the only aircraft in the RAF inventory with a designating capability. This was always something that concerned me and I asked AVM 'Sandy' Wilson, our original in-theatre Air Commander, to approach General Horner over deploying some Buccaneers but he received much the same answer as AVM Wratten got later.

I wish now that I had pressed the point earlier. If I had done so, we might have avoided that unfortunate hiatus which lasted 11 days and during which we really were not achieving very much at all. That in turn caused some difficulty for us with MOD. During the Options for Change Defence Review earlier in 1990, there had been considerable pressure to reduce the number of Tornado GR1 squadrons on the basis that this aircraft was the most expensive in the RAF's inventory. Once the JP233 phase had been successfully completed and we began medium-level bombing, the MOD wanted to know how we were doing. It took a while for the Battle Damage Assessments to come through but, when they did, the results were pretty unimpressive – hence the embarrassment and concern, although for people who understood the art of the possible, the poor results should have come as no surprise. It is important to appreciate that this was not exclusively an RAF problem; most of the USAF were also dropping dumb bombs from medium level with similarly disappointing results. With hindsight, of course, I wish that I had myself taken up the need for the RAF to have its own LGB capability in theatre with either

Horner or ultimately Schwarzkopf.

Air Cdre Bob Lightfoot. One of the more unpleasant legacies of this war is concern over the effects of the inoculations that were administered to counter Saddam's biological agents. From my perspective in the MOD, it all seemed pretty unsatisfactory. We had anthrax readily available, through the livestock and butchery business, and we brewed up something for botulism using Porton Down's goat herd – and I had the rather unusual job of disposing of the herd after the war. There were two other biological agents as well, although Porton Down didn't actually have a biological agent detector until the MOD was able to find a way to help them with that. In total we thought that everyone would have four inoculations, but it turned out to be five because, in-theatre, there was concern over pertussis being released – and on top of that, I believe that there was an insect repellent spray being used around the tented accommodation. At MOD we were only aware of the original four jabs and it seems to me that asking untrained troops to sign a piece of paper consenting to being given all these inoculations was a bit unfair. How did this play in theatre?

Hine. Well, we obviously felt obliged to provide our people with as much protection as possible against the projected chemical and biological threat posed by Saddam. Hence the cocktail of injections that you mentioned. Some people thought that this was unnecessary but we at the JHQ and the MOD took the view that we should go ahead with the programme. Not to have done so would surely have been regarded as irresponsible if the threat had actually materialised. I recognise that there have been some post-war ramifications from that decision, but I really do not see what else we could have done at the time.

Air Cdre Geoff Simpson. I felt very uncomfortable about the way the vaccination programme was handled and, particularly about the multiple injections. While my people may have been prepared to sign for a single vaccination (eg anthrax or plague), trusting advice that it was safe and necessary, I know there remained major reservations about the cumulative impact of having four or five different jabs and pills at the same time.

I am convinced – as were some of the doctors who treated me in

Belgium and the UK – that, notwithstanding that I did not have any significant side-effects at the time, the subsequent break down in my immune system, some six months after the event, probably had some link to the four or five treatments I received in just 48hrs; certainly, I have never had anything like it before or since.

Air Cdre Graham Pitchfork. A question for Jerry. In the past the air force has always fought using formed squadrons. You found yourself commanding a detachment composed of elements drawn from, I think it was, five squadrons, and including two other Squadron Commanders. How did that work out? – and was that the right way to have done it?

Air Cdre Jerry Witts. It was six squadrons actually, with the odd individual from even more. But it worked because of *esprit de corps* – the guys just lumped in together and got on with it; in effect we formed our own Tornado squadron with its own identity. As members of the Tornado community, most of us already knew each other from around the bazaars and it just worked. Perhaps the best evidence I can cite is that, twenty-five years later we held a reunion – and everybody came.

Hine. You raise a very interesting issue. We decided very early on, at the instigation of AVM Wilson, to deploy only our most proficient GR1 crews, thus excluding those who, while officially declared combat ready, still lacked front-line experience. So the initial cohorts were our most experienced people who were drawn from across the GR1 force to create mixed squadrons. At the time, of course, we did not know when the fighting might start. If Saddam had decided to invade Saudi Arabia, we would have been at war within days. As the likelihood of that subsided, we had to decide how long we were to keep in theatre crews who had been training hard at very low level in high ambient temperatures, and we concluded that three or at the most four months was about right. As a result, a progressive rotation of crews started in December. Shortly thereafter, the timescale for war became clearer but by then we were committed to the changeover.

The lesson for me was that when someone is declared combat ready, then he is ready for live operations. If you go to war with constituted squadrons, then the crews will inevitably possess varying

degrees of experience and skill, but they will all, by definition, be capable of doing the job. As it was, the more junior crews that came out with the rotation actually did very well, some of them performing better than some of the most experienced crews, which goes to show that if a crew has been certified as combat ready, they should do the job well regardless of how many hours they have on type.

Al Pollock. It was a British company that designed and built Saddam's bunker. The American's had some pretty impressive bombs, so why wasn't it attacked? Was there a political decision to leave it?

Wratten. Our target was Saddam himself, not the many places that he might be hiding, so a particular bunker was not actually a target unless he was known to be in it. Quite a lot of effort was expended on trying to locate Saddam but, as we now know, he was constantly on the move and rumour had it, with some justification I believe, that he used a taxi to stay mobile during the dark hours. Some quite sensitive sources were involved in trying to find him but we never did track him down. We got quite close on occasion, but we were always too late. And, to my knowledge, his bunker was never targeted.

Mike Thompson. There were stories at the time that if Saddam were to use chemical weapons, we would retaliate in an appropriate fashion. I recall, for instance, newspaper articles suggesting bombing reservoirs to flood Baghdad. Was there any truth in any of this?

Hine. At least a grain. Jim Baker, the American Secretary of State, had made clear to Tariq Aziz at a meeting in Geneva in the run-up to war that if Saddam used chemical and/or biological weapons, there would be a response in spades. I believe that Saddam, correctly, interpreted this warning as a risk of nuclear attack and he would have assumed that the Americans had nuclear weapons available in theatre. So he did not use WMD against us. That said, we knew that he had used chemical weapons against Iran and his own people, and we had to expect that he might use them against us, especially against coalition ground forces which would have been particularly vulnerable during the initial breakthrough to chemical attacks delivered by artillery. But in the event the Americans were successful in deterring him.

Wg Cdr John Stubbington. What were your personal feelings about

the decision to stop after that remarkable 100-hour campaign?

Hine. My personal view is that we stopped too soon. We were only 24-36 hours away from completing the encirclement of the Iraqi army inside Kuwait, which would have enabled us to neutralise all the remaining armour and artillery before letting the soldiers go home to Iraq. But for various reasons, notably the destruction of Iraqi convoys by air attack when caught in the Mutla Pass as they retreated from Kuwait City towards Basrah, that did not happen. Colin Powell was concerned that the international media would give us a lot of stick as a result of this so-called 'turkey shoot', so he was keen to call a halt. I don't think Schwarzkopf was too upset about it either because he had won a spectacular victory on the ground in just 4 days and with only very light casualties – about 250 dead across the whole coalition. He was always concerned about incurring heavy casualties, and it was arguable that had the Iraqis been trapped inside Kuwait, the remaining Republican Guards might well have fought much harder in order to get out. The facts were that the Iraqis were withdrawing in disarray, and we had liberated Kuwait and were thus in a position to restore the legitimate government, ie the UN mandate had been fully met. In the light of that, Powell won the day in Washington and persuaded President Bush to suspend all offensive operations. As I said, I personally would have preferred to finish the job off. Incidentally, the UK was not consulted – not even the Prime Minister; he was simply informed that the American Administration had decided on a cease-fire.

Wratten. I think that, if the world had been able to see what the Iraqi Army had done to Kuwait City – the pillaging, the wanton destruction – and the war crimes that had been committed – I think there would have been a better understanding of what was happening on the Basrah Road. That wasn't Iraqi kit that was being destroyed, it was looted Kuwaiti possessions, most of it in stolen Kuwaiti vehicles. If more publicity had been given to those aspects, rather than the carnage, who knows whether there might not have been a different outcome. Incidentally, speaking for myself, I saw no evidence of the rumoured distaste that the aircrew were said to have had for what they were doing on the Basrah Road. It was a target and that was that.

The Basrah Road.

Hine. It occurs to me that embedded in your question, you may have been asking whether we should have gone on to Baghdad. My answer to that would have been 'No'. It would undoubtedly have been the wrong thing to do, and we were ill prepared to do it. In a purely military context, we could I suppose have paused, regrouped and allowed the logistics to catch up, and then gone on, but this war was not about regime change. We had held bilateral discussions with the Americans on this issue before the conflict started, in which I was involved, but it was agreed that that unless Saddam made extensive use of chemical weapons and inflicted heavy casualties on us as a result, we would not march deeper into Iraq.

Air Cdre Mark Leakey. Given that all this was only a matter of months after the end of the Cold War and well before the establishment of the Permanent Joint HQ at Northwood, Sir Paddy, how intellectually and doctrinally prepared did you – and your staffs – feel about handling an operation of this sort.

Hine. I was a bit of a heretic over the creation of the Permanent War HQ, basically because of the very satisfactory experience we had had at High Wycombe in 1990-91. MOD had then appointed a single Joint

Commander and designated one JHQ to control all UK operations by naval, air, land and Special Forces, and it had all worked very well. I do not recall encountering any major problems affecting inter-Service relationships, and both the Navy and Army fielded excellent Deputies to join us in the JHQ. So, from my perspective, I could see no real need for a new and different HQ with associated additional overheads. Dick, do you have a view?

Air Chf Mshl Sir Richard Johns. All I would add is that in July 1990 we had just completed the first full-scale, three-week, out-of-area exercise to be controlled from the new bunker at High Wycombe and that experience stood us in good stead when a few weeks later we were committed to Operation GRANBY as a *Joint* HQ.

I would echo what Sir Paddy said about the perceived need to establish a Permanent JHQ at Northwood, which was one of the recommendations arising from the 'Frontline First' defence review of 1994. At the time, I thought that, in the light of our recent GRANBY experience, and with the military adjusting to significant force level and manpower reductions, it was hardly the time to revise the C2 arrangements that had so recently been tested and shown to work. I was Chief of Staff at Strike at the time and both I and John Thomson, who was then CinC, were vociferous in our opposition to the project, as was John Wilsey, who was CinC Land down at Wilton; the only supporters of the PJHQ proposal were at Northwood. But – three or four years later, I had changed my mind. It had been the right decision. I don't think that, in 1994, any of us had any perception of the way in which the world was going to change and the manner in which our forces would find themselves committed to a series of operations, some large-scale, some small – but often concurrent. With the benefit of hindsight, I don't think that we could actually have managed all that from High Wycombe as well as it has been done from Northwood under a Chief of Joint Operations – a CJO – with his own joint dedicated staff

Stubbington. Target selection. Was that entirely a matter for General Schwartzkopf and his in-theatre military staff, or was there some higher political guidance?

Hine. Our politicians didn't interfere in target selection at all.

Wratten. Target selection was entirely a matter for the Planning Cell, in the light of the latest guidance emerging from the regular O Groups. Any uncertainty would have been resolved locally by reference to General Horner, or if he was uncertain, by General Schwartzkopf. But I doubt that that ever happened, because the targets were reasonably obvious. There were some sensitivities after we had a couple of wild bombs – you may remember an incident in Fallujah where an LGB had simply failed to guide. From then on we were more careful about planning our line of approach to a target. In reality, that was more of public relations exercise than a practical limitation, because there is no telling where a wild bomb will go – it just 'looked better'. Target selection was a local matter for the Planning Staff.

Hine. The only incident that I am aware of that caused a bit of consternation in Washington was the bombing of the so-called air raid shelter in Baghdad. It had been a stand-by command and control centre and used as such in the past. There was good intelligence indicating that it had been reactivated. It was therefore targeted and hit, very accurately, by a F-117. Unfortunately, as we now know, the bunker was not being used operationally but instead to shelter families of a number of senior Iraqis, a substantial number of whom were killed. That did result in Washington taking a little more interest in the targets being attacked in Baghdad.

JOINT COMMANDER'S CONCLUDING REMARKS

We have had a long day and I will not therefore attempt to sum up the day's proceedings. Suffice to say that we have had some excellent and varied presentations, for which I should like, on behalf of yourselves and the Society, to thank all the speakers.

Given the size of the Iraqi ground forces committed to the Kuwaiti theatre of operations and their well-prepared defences, it was essential through the use of air power to gain air supremacy, to prevent Saddam from effectively controlling his forces, and to both isolate and prepare the battlefield through interdiction. The highly intensive and successful air campaign, lasting five weeks, and to which the RAF made a significant contribution, was the prelude to a quick and decisive ground operation that defeated the Iraqi forces within just four days. The media sometimes portray this conflict as the 'Hundred Hours War' but it was in truth a predominantly air war that graphically and clearly demonstrated that with precision guided weapons (PGW) air power had at last come of age. PGW proved particularly effective in destroying key strategic targets in and around Baghdad, but they were also effective against a wide variety of tactical targets such as key bridges, hardened aircraft shelters and individual tanks. We should remember of course that only about 10% of all the air weapons delivered in Gulf War I were 'smart' and that an all-weather precision bombing capability had yet to be developed. That came later in time for Gulf War II.

The Gulf War of 1991 was a sharp reminder of what can happen to even a large and well-equipped army when caught in open ground against an opponent enjoying total air supremacy. I sometimes felt that our politicians have come to take air supremacy as a given, but in future we may well face situations where we have to very fight hard to obtain air superiority, let alone air supremacy.

It is a sobering thought that at the time of Gulf War I, the RAF had twenty-eight front-line fast-jet squadrons: eleven Tornado GR squadrons and six of Tornado F3s, three of Jaguars, three Harrier, two Buccaneer and three Phantom equations. We also still had a Canberra squadron which, while not used in the 1991 conflict, continued to provide very useful photographic reconnaissance until well after Gulf War II. By comparison, when current MOD downsizing plans are

fully implemented in about a year's time, the RAF will have just seven fast-jet squadrons, with the possibility of a further Typhoon squadron being added later to the order of battle. That represents a 75% cut in the RAF's combat front line since 1991 – a huge reduction that carries a very significant risk to our national security interests in an increasingly unstable world. Unless the UK is prepared to accept more tightly-drawn restrictions on its future involvement in military operations, it will certainly need to place greater emphasis on combat air power than it has over the last 20 years.

Finally, let me say what a great honour and privilege it was to have been Joint Commander of our forces committed to Operation GRANBY. And let me pay tribute to all our servicemen and women who took part, not just in our combat units but also all those who in one way or another supported our forces so well, none more so than the logisticians and communicators who worked absolute wonders.

I hope that you, the audience, have enjoyed your day and that from the presentations and subsequent discussion periods you have learned things that were new to you, and notably about the part that the RAF played during this conflict. In my view, all those involved, especially our aircrew, more than upheld the proud traditions of our Service, and are well deserving of the nation's gratitude.

Thank you for coming, have a safe journey home, and have a pleasant weekend

BOOK REVIEWS

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

Buccaneer Boys by Air Cdre Graham Pitchfork. Grub Street; 2013. £20.00.

There have been several recent 'Boys' books devoted to a particular aeroplane or campaign and the (by now often septuagenarian) folk who flew them or participated. *Buccaneer Boys* is a particularly good example of the genre. While billed as the author, Graham Pitchfork did far more than merely record his personal reminiscences. As the driving force behind the project, his real contribution was in persuading other members of the Buccaneer Aircrew Association to put pen to paper, probably no mean feat in itself, and then editing the results. The end product is a collection of stand-alone essays reflecting the experiences of about twenty-five individuals. Half of the contributors are, or were, RAF pilots with the balance being made up of RN, SAAF and USAF pilots, RAF and SAAF navigators and a solitary RN observer – albeit one with 2,500 hours on type and 600 carrier arrests.

The breadth of experience embedded within this selection provides an insight into Buccaneer operations from the perspective of a first tourist, via OCU instructor, QWI, Flight and Squadron Commander to Station Commander, and even some thoughts at AOC level. The aeroplane's 33-year career embraced flying from aircraft carriers and shore bases in the strike/attack role in both overland and maritime scenarios, including participation in live operations in Angola and in the 1991 Gulf War. Along the way, it invariably impressed in realistic training events like Red and Maple Flag, repeatedly demonstrated its effectiveness in major exercises and, for good measure, participated in the Beira Patrol, brewed-up the Torrey Canyon in 1967 and 'wired' Beirut in 1983. All of these activities, and more, are described in this book.

While the air marshals of the 1960s had been content to help out by providing RAF aircrew to fly RN Buccaneers in order to make up a deficit in FAA manning , having set their sights on the TSR2 and then the F-111, they had never wanted to 'own' any of the Navy's second-

best ugly ducklings. The demise of the aircraft carrier forced their hand, however, and when obliged to adopt the orphaned aeroplane, the RAF found that it had actually acquired a star performer – something that the 'boys' who had been flying it for some time already knew.

There is, inevitably, a degree of repetition in the tales told in this book, not least because everyone's exposure to the aeroplane began at the OCU, and it is evident that the first flight in a Buccaneer, especially in the underpowered Mk 1s, tended to make an indelible impression on a pilot and, since there was no two-stick model, this experience could be equally memorable for the instructor in the back seat. Other recurrent themes are a universal recognition of the value of having a second man in a crew, the mutual respect between pilots and GIBs (guy in the back), the ease with which RAF and RN personnel integrated and the degree of executive and supervisory authority that was vested in navigators – relatively commonplace today, but I believe that the Buccaneer community were trend setters in this respect.

I use the term 'community' advisedly, because it is very clear that the men who flew the Buccaneer saw themselves as members of an exclusive club. While their aeroplane may have looked a little odd to some, it was actually an extremely capable long-range load carrier and no slouch at the lowest of low levels. To get the best out of it, it needed to be flown with élan and to do that the aircrew needed to be just a bit special – and the OCU's reputation for taking no prisoners will have ensured that most of them were. As a result, they felt like an elite. They were good, and they knew it, and, being relatively few in number, they all tended to know each other (so the same names tend to keep cropping up in the narratives), all of which had a positive influence on their corporate professional performance – and their considerable reputation for their ability to 'socialise'.

I found this 223-page hardback, with its two photographic inserts, a delight. The descriptions of flying activities and incidents are vivid, some of the anecdotes are laugh-out-loud amusing and references to that sense of 'community' and a real affection for the aeroplane just keep cropping up. If there is a deficiency, it is the lack of a direct contribution by any groundcrew. But this is a book by, and about, aviators and many of them do acknowledge in passing the extent to which they depended on technicians and logisticians – indeed David

Wilby provides some balance by devoting several paragraphs to this issue.

Having really enjoyed reading this book, when I reached the end I was surprised to find that my residual emotion was – resentment. Why? Because I had been obliged to spend most of my flying time sitting facing backwards in the dark in the bowels of a Vulcan while these other guys had been having such fun. Boo to the posters. If you are prepared to risk a similar reaction, I strongly recommend this book. It's a very good and very entertaining read.

CGJ

The Avro Type 698 Vulcan by David W Fildes. Pen and Sword; 2012. £30.

The previous Chief Executive of the Royal Aeronautical Society and I first met on the flight deck of an Avro Vulcan B2 at RAF Oakington in 1967. It had been brought in to convince trainee multi-engine pilots that we should join No 1 Group of Bomber Command and Keith Mans was sufficiently smitten to wax lyrical about the mighty delta. It would be ten years before I got to fly the Vulcan but Keith was right – it was a tremendous machine and one for which I have only the fondest memories. I nearly lost a Canberra once – never a Vulcan, and the fact that it looked after a whole host of aircrew while being a primordial weapon of war spoke volumes for the firm foundations on which the 'flatiron' was built.

Brian Fildes' overview of the design and development of the Vulcan is an obvious labour of love. There have been some terrible 'cut and paste' histories of the Vulcan over recent years but as soon as I saw that this volume had been endorsed by Harry Holmes, chairman of the Avro Heritage Centre, I knew we were in safe hands. This isn't a chatty read – rather it's a marvellous compendium of the evolution and chronology of the Vulcan from the original specification through every bit of kit on board to specialist advice for model makers. It is a tremendous book for dipping into and for finding yet another serendipitous piece of fascinating information. I interviewed many of the original design teams in the 1970s and I propped up the bar with Avro chief test pilot Roly Falk at Scampton in 1981. But I never knew that some Avro bright spark proposed a low-level target marker version in the 1951 Type 698 Design Brochure. Best of luck with that!

The content and the price of the book are right. The bulk of the book is focused on the early years but there is a mine of hitherto unpublished archive documentation and photographs to enjoy. This is not an operational history but it doesn't pretend to be. The paper projects – the Vulcan interceptor, the VSTOL Vulcan – verge on the barking, but they reflect a bygone age when British aerospace was at the forefront in so many fields and national self-confidence was boundless. Acting the clever clogs I tried to find some howlers to point up, but I couldn't. David even mentions the celebration of the Vulcan's twenty five years in service which was held at Scampton on 25 July 1981. He doesn't mention that AOC 1 Gp tasked me with producing the cabaret but I forgive him.

Read this 487-page, extensively illustrated book and gaze on XH558 in wonder. I will leave the last word to Harry Holmes. 'I have no hesitation in commending this book as the definitive work on what has become an icon of aviation, the Avro Vulcan.' I couldn't have put it better and you will not find a better Vulcan book.

Wg Cdr Andrew Brookes

The Great Escaper – The Life and Death of Roger Bushell by Simon Pearson. Hodder & Stoughton; 2013. £20.

The year 2014 marks the 70th anniversary of the mass escape by RAF and Allied officers from *Stalag Luft III*, an event immortalised in Paul Brickhill's *The Great Escape* and the Hollywood film of the same name. The mastermind behind this epic event was Squadron Leader Roger Bushell.

Brickhill's account provides a sketch of an intriguing man but it is tantalizingly short on detail and the subsequent film did little to increase our knowledge of Roger Bushell. Over the years, *The Great Escape* has become established as one of the most enduring stories of the war and the regular showing of the film has established a public perception of Bushell's personality and his achievements.

Brickhill's other popular books made into films, *Reach for the Sky* and *The Dam Busters*, focussed on the respective heroes, Douglas Bader and Guy Gibson, making them into national icons. Roger Bushell on the other hand has remained something of an enigma and is largely unknown. In the film *The Great Escape* he was depicted as a composite character called Roger Bartlett with the completely fic-

titious character played by Steve McQueen overshadowing his pivotal role.

Simon Pearson, a well-respected and experienced journalist, who is currently the night editor of *The Times*, decided it was important to correct this narrow perspective and he has written the first biography of this unique RAF officer. He was given unprecedented access to Bushell's private papers, which his family donated to the Imperial War Museum in 2011. This wonderful collection includes very many of his letters including those written during his time as a POW.

As one might expect of a man whose brilliance was responsible for the planning and subsequent greatest-ever mass escape, the charismatic Bushell's talents spread across a wide spectrum of activities. The son of a South African mining engineer, he was educated at Wellington College and Cambridge University before becoming a London barrister. He was a renowned champion skier, a pre-war fighter pilot with 601 Squadron (the Millionaires' Mob); he spoke nine languages and had a string of glamorous girlfriends.

Bushell was shot down in his Spitfire over France in May 1940. From that moment he was determined to escape and to cause as much disruption to the German war machine as possible. He was soon established as a key man in the escape organisations set up in various camps. A fellow POW described him as 'the organising genius behind all our escaping exploits'. He also played a key role in developing MI9's coding system for passing military intelligence back to London. The author develops this aspect in his narrative and it provides a fascinating insight into this largely unknown role conducted by Bushell.

He made his first escape at the end of May 1941 and was within 100 yards of the Swiss border when he was apprehended. Four months later he made his second bid for freedom, this time with a Czech fighter pilot. They soon reached Prague and linked up with the Resistance. Here the Zeithammelova family sheltered them and Bushell soon established a passionate liaison with the daughter. He remained in Prague for eight months at the time when SS General Reinhard Heydrich ruled Bohemia and Moravia with a cruelty that witnessed some of the *Gestapo's* worst atrocities.

Betrayed in May 1942, Bushell was arrested by the *Gestapo* and interrogated. The Zeithammelova family were also arrested and, four

weeks later, all were executed. Within days of their arrest, Heydrich was shot and he died some weeks later. There is no evidence that Bushell had played a role in his assassination but he was taken to the *Gestapo* HQ in Berlin and subjected to three months of harsh interrogation where it was made clear to him that if he came to their attention again, he would be shot.

Once at *Stalag Luft III*, Bushell assumed the role of 'Big X'. To distract German attention he was involved in other activities including the collation of intelligence but he continued to mastermind escape efforts and the construction of three tunnels. Despite the threats to his life by the *Gestapo*, Bushell, driven by his love for Lady Georgiana Curzon, was determined to escape and he was one of the first of the seventy-six POWs to leave the tunnel 'Harry' on the night of 24 March 1944. Travelling with a French pilot (not a Scotsman as portrayed in the film), their language skills saw them travel quickly by rail to the French border where they were arrested. Within days they were driven along an autobahn and during a halt they were murdered on the explicit orders of Hitler. Forty-eight of their colleagues suffered the same fate at the hands of the *Gestapo*.

The author describes Bushell's life and character, flaws and all, by a sensitive use of the collection of family correspondence, painstaking research in Poland, the Czech Republic, South Africa and the UK, the comments by those who knew him best before combining them all with the wider historical aspects of the period. He shows Bushell to be a complex man, a maverick, a romantic, and an intellectual whose courage galvanised and encouraged men to continue to fight after all seemed lost. He gave hope and opportunities to many who might otherwise have given up but it was all to cost him his life. Group Captain Herbert Massey, the Senior British Officer of *Stalag Luft III*, best sums up Bushell saying, 'He was one of the greatest men of his generation, a great officer, an outstanding leader of men, and quite fearless.'

The author unfolds all the evidence to support that claim and he is to be congratulated for providing us with such a complete picture of a man once described as a 'man lost in history'. No longer.

I found this well-produced 436-page hardback, with its 39 b/w photographs, many references and footnotes, a compelling and gripping read, which has presented many more fascinating insights into

Bushell's character and has provided us with the first complete, and authoritative account of his short but remarkable life.

This is a book that should adorn the shelves, not only of those with an interest in the RAF, but by all those who cherish the spirit, fortitude and courage that men can, and do, display when in the greatest danger. Strongly recommended.

Air Cdre Graham Pitchfork

A Century of Air Power - The Changing Face of Air Warfare 1912–2012 by Dr Dave Sloggett. Pen & Sword; 2013. £19.99

A Century of Air Power is neither easy to read nor to review, especially given the unqualified enthusiasm of the author of its Foreword who has but recently stood down as CAS! The book is certainly wide-ranging, covers much ground and many of its conclusions are unarguable, if curiously expressed. What for one reader suggests 'mastery of analysis, synthesis and the ability to describe insightfully and effectively the use of air power', is for another, sadly, more of a curate's egg.

Dr Sloggett is highly regarded for his regular contributions to aviation journals which are invariably crisp, accurate and informative. It is therefore disappointing to record that this book is rather rambling, repetitive and superficial in places and, less subjectively, to state that it harbours a number of howlers in terms of historical accuracy and minor detail. The author plainly has favourite words, which crop up repeatedly, notably 'lexicon' and 'paradigm', the latter appearing four times on a single page. Some of the language is rather flowery and tends to obscure what, otherwise, seem to be sensible conclusions. It is not clear for whom the book is intended.

A Century of Air Power is probably strongest in its consideration of Counter-Insurgency operations, a field in which Dr Sloggett is well respected. His views on the impact of the Media on the conduct of operations and on the significance of 'collateral damage' are especially sound. His reflections on the utility and application of air power in the future are thought-provoking, if not particularly original. Other conclusions, such as his admittedly qualified endorsement of the proposition that the outcome of the air war over the Beqaa Valley may have been instrumental in the development of Glasnost, may just go too far!

Dr Sloggett's book probably deserves a readership with more intellectual muscle than this reviewer can deploy. That the author has tackled a vast subject area is undeniable and it may be that he has bitten off more than he can chew within the constraints of 193 pages. Indeed, it is probably for that reason that *A Century of Air Power* gives the impression of being a rapid canter across the ground, of doing scant justice to some of the essential 'enablers' of air operations and of lacking the rigour that might have been expected of such a work.

This review will undoubtedly encourage other members of the Society to read the book for themselves!

AVM Sandy Hunter

Cold War Shield, Vol 2 by Roger Lindsay. Available from specialist aviation bookshops or direct from the author/publisher at http://www.coldwarshield.co.uk £60 (inc UK p&p).

This is the second of, what will now be a three (rather than the anticipated two) volume series. The downside to that is the cost. Vol 1 was originally priced at £39.95 but that was clearly uneconomic and this one is £60. That said, the price is the only downside and you really do get your money's worth.

Cold War Shield sets out to tell the story of the RAF's fighter squadrons, at home and abroad, throughout the 1950s, a remarkable decade bookended by the demise of the Spitfire and the advent of the Lightning. Vol 1 covered the Spitfire, Tempest, Hornet, Mosquito and Meteor. Vol 2 deals with the Vampire, Venom and Sabre and expect a Vol 3 (in a year or two) to cover the Swift, Javelin and Hunter with just a dash of early Lightning.

The bulk of the book is a blow-by-blow account of each squadron's activities presented as a, typically three- or four-page narrative, enlivened by embedded personal anecdotes contributed by those who were there. These add considerable contemporary 'atmosphere', some conveying a vivid impression of what it was like to be on a fighter squadron in the 1950s. For each squadron, the dates on which each aeroplane was taken on charge are tabulated along with the date of its disposal, together with where it went. When an aeroplane was written off, there is a brief note indicating why and identifying fatalities where these occurred.

Vol 2 is a little slimmer than its predecessor, but it still runs to 368 glossy A4 pages with more than 600 photographs, some in colour, plus a selection of profile drawings of representative individual aircraft and the best full-colour renditions of the classic squadron 'bar' markings of the 1950s (contributed by Alan Carlew) that has yet appeared in print – only a proportion of them, of course, because the others are associated with types which have been/will be covered in other volumes.

Much of the above is condensed from my review of Vol 1 in Journal 47 (*qv*), but don't take my word for it. Go to the publisher's website where you can examine selected pages yourself. The quality is self-evident. My closing remarks on Vol 1 were 'Not cheap, but worth every penny. Highly recommended. If I hadn't secured the review copy, I would have had to buy one.' This time, rather than obliging this enthusiastic, self-funded, self-publisher to absorb the cost of another 'freebie', I did buy one – sight unseen. I just knew that Vol 2 would be as good as Vol 1 – and it is. It is a reliable databank of information on the RAF's fighter squadrons of the 1950s and the many reminiscences make browsing a pleasure.

The last word on the quality of this series is that Vol 1 is currently out of print, with second-hand copies being advertised at between £100 and £150. A short-run reprint is being arranged.

CGJ

Tangmere – An Authorised History by Reginald Byron and David Coxon. Grub Street, 2013. £25

One the RAF's most famous and important fighter airfields in Britain, Tangmere was strategically located in the forefront of the defence of this country from its beginnings in the First World War until the post-war years. This well-researched 352-page book, with its three eight-page photographic inserts, traces its history from those early days until its closure in 1970. In addition to its importance in wartime, the airfield became well known for the exploits of its fighter squadrons, not least at the RAF Pageants at Hendon.

With the outbreak of the Second World War, one of its squadrons, No 1, was the first to be sent to France where it gained some success in the ill-fated operations. The station then played a key role during the Battle of Britain. Situated on the south coast, it bore the brunt of

many of the *Luftwaffe*'s attacks against the south of England. By the spring of 1941 Fighter Command had taken to the offensive over northern France and, during the 'high summer' of 1941, the Bader Wing achieved much success with luminaries such as 'Johnny' Johnson, 'Cocky' Dundas, Denis Crowley-Milling and others making a big impact before going on to greater success later.

Tangmere also had other important roles and the authors pay due tribute to the 'Moonlight Squadrons', and in particular Lysander pilots who departed from the airfield on their lonely flights to sparsely lit fields in France sometimes returning in marginal weather conditions.

But it was as a fighter station that Tangmere will best be remembered. Support of the Dieppe raid, intensive fighter sweeps over France and a pivotal role during operations in Normandy in support of the Allied landings made the base one of the busiest in the RAF.

With the end of the war, and a different kind of threat, it was no longer well positioned as a fighter base and by 1958 Fighter Command had withdrawn its last squadrons. However, it had been in the public eye in 1946 when the High Speed Flight was based on the airfield during its successful attempt to break the world air speed record. Seven years later, Neville Duke flew his Hunter from Tangmere to create another record.

After a period as a Signals Command station, Tangmere finally closed in 1970. All that is left today is the excellent Military Aviation Museum, which records the rich history of this once very active airfield.

The authors could hardly be better qualified to relate the fascinating history of Tangmere. Reg Byron has been the archivist for six years and is the editor of the museum's magazine *The Tangmere Logbook*. David Coxon is the museum's curator. Despite the title, they also include other local airfields that came under the umbrella of the Tangmere Sector in WW II, including Westhampnett (now Goodwood airfield), Ford and Shoreham. In relating the fascinating history of the airfields, they make extensive use of primary sources; in particular squadron operations record books, but also draw on personal reminiscences.

The book is a very good read but also serves as an excellent reference book with two comprehensive appendices listing units and

dates of airfield occupation and brief histories of the sector airfields.

There are other good features of the book with some excellent, and evocative, photographs and a print size that is most helpful to those of us who perhaps no longer have A1G1Z1 eyesight.

Airfields are the very essence of RAF life and activities and, as so many close down to revert to their former use and disappear from the landscape, it is important that those activities and lifestyles pass into the RAF's heritage. Sadly, too few enjoy the treatment that the authors of *Tangmere* have given to this famous fighter airfield. We owe our thanks to them, and to the publisher, for ensuring that Tangmere's history is available for future generations to understand and appreciate.

Air Cdre Graham Pitchfork

ROYAL AIR FORCE HISTORICAL SOCIETY

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

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

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

Membership of the Society costs £18 per annum and further details may be obtained from the Membership Secretary, Dr Jack Dunham, Silverhill House, Coombe, Wotton-under-Edge, Gloucestershire. GLI2 7ND. (Tel 01453-843362)

THE TWO AIR FORCES AWARD

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

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

THE AIR LEAGUE GOLD MEDAL

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

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

SECRETARY
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1 Park Close
Middleton Stoney
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MEMBERSHIP SECRETARY
(who also deals with sales of publications)
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