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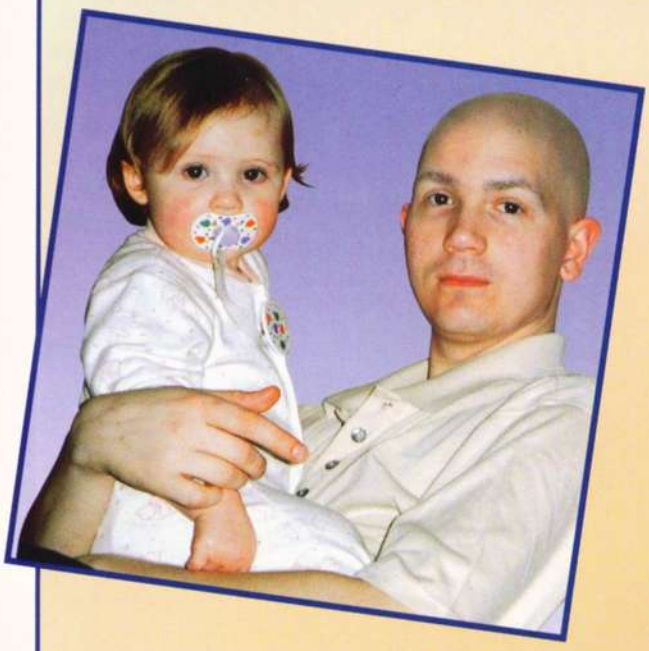

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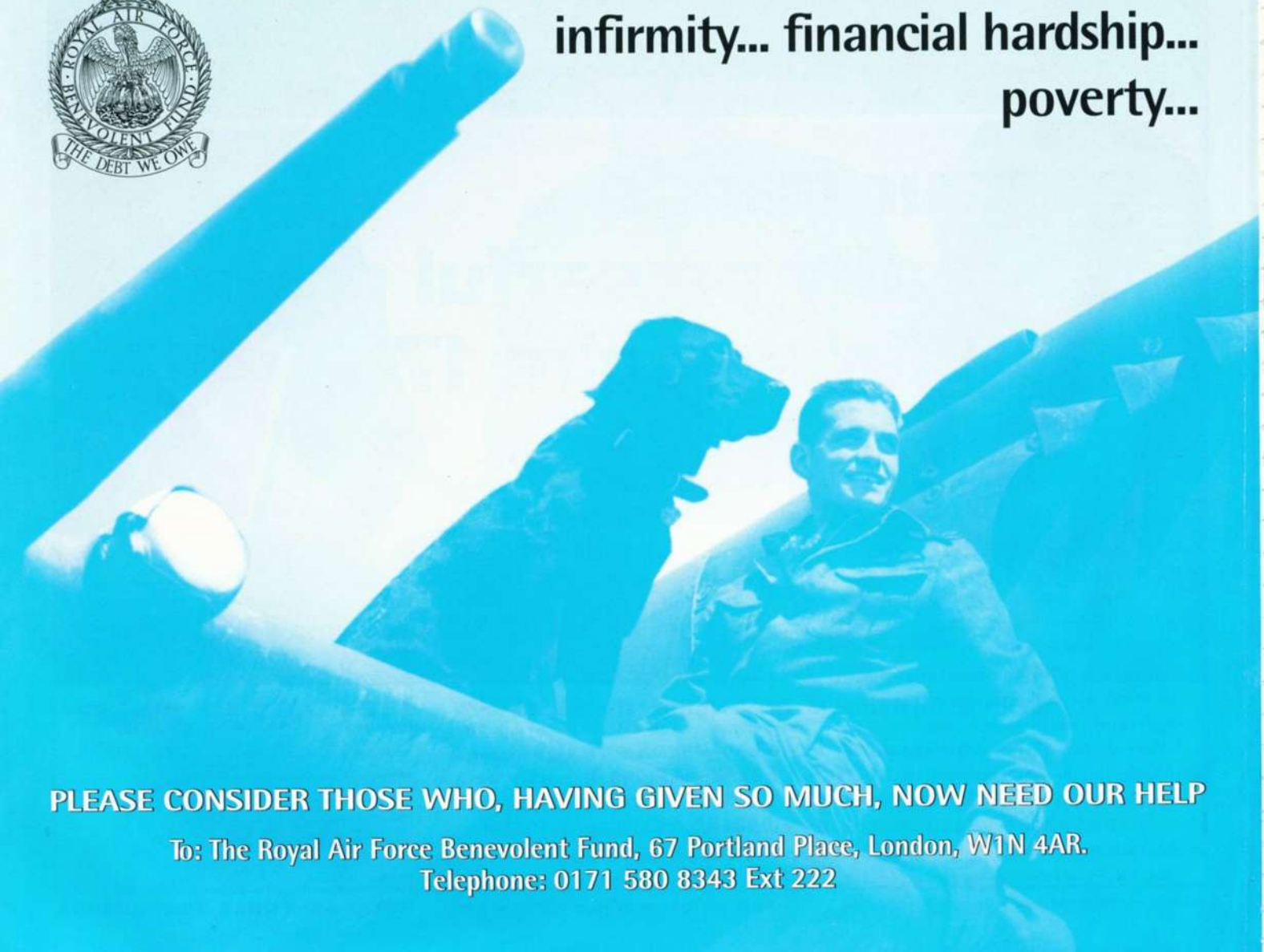

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INTRODUCTION

Air Chief Marshal Sir Richard Johns
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I was delighted to receive the Benevolent Fund's invitation to write the Introduction to the 1998 Royal Air Force Yearbook – the year in which the Royal Air Force celebrates its 80th anniversary, as well as marking the anniversary of the Berlin airlift to which the Royal Air Force made a very significant contribution.

As we remember our birthday on 1 April 1918 it is perhaps worth reflecting for a moment on why the Government of the day decided to amalgamate the Royal Flying Corps and the Royal Naval Air Service into an Independent Air Force. First, it was judged that competition between the two Air Services was causing an extravagant duplication of resources, manpower and facilities; union would eradicate such wastefulness. Secondly, the inability of the two Air Services to co-ordinate their activities to repulse German air attacks on London in the Summer of 1917 provided the Government with an operational rationale for their merger. Finally, men of strategic vision had concluded that an Air Service could and should be used as an independent means of war operations far from and independently of both Armies and Navies.

In the following 80 years air power was to develop within the evolutionary process of warfare as a whole until it came of age in the Gulf War. The air campaign in that conflict lasted 39 days and provided a formidable demonstration of air power's capabilities which served to underline an enduring concept of air power thinking – that command of the air is an essential pre-requisite for all military operations, whether they be on land, at sea or within the ocean of air that cloaks our world. The application of air power has thus become a business of considerable complexity which demands its own discrete professionalism and technological mastery – and we are reminded of this every day as the Royal Air Force continues its active involvement in a wide variety of operations in this unstable post-Cold War world. From the Falkland Islands to Saudi Arabia, from Turkey to the former Yugoslavia, every one of our operational aircraft types is either engaged on operations or on immediate standby for deployment.

As the Royal Air Force looks to the future we eagerly await the arrival into service of Eurofighter, but before then we will take delivery of the new Hercules C-130J, the Merlin HC3 helicopter, the Nimrod 2000 and the Tornado GR4. These exciting programmes, together with new weapons, will ensure the Royal Air Force continues to provide effective air power in the national interest – air power that will offer the Government a range of capabilities equally apposite to high intensity and low intensity operations, and to the protection of friends and the preservation of international law.

But the best equipment in the world will count for nothing if we do not have the right men and women to operate it. People are our most important asset. For the foreseeable future we will continue to need top quality, well trained and highly motivated personnel to meet our many operational duties. But the demands we place on the men and women of the Royal Air Force can extract a personal cost and it is here that we all owe so much to the Royal Air Force Benevolent Fund which stands ever ready to help in every way.

Your continuing support for the Fund, in this the eightieth year of the Service's history, is vital, and will be a token of your appreciation of the Royal Air Force's contribution to the well being of our country, and of its men and women who serve the nation with pride and commitment.

Richard Johns

No 100 Squadron

Aggresso

Bob Archer

The first unit to undertake the 'aggressor' role within the RAF, No 100 Squadron's Hawks provide air combat training for the Tornado F3.

Deep within the operational area adjacent to hangar three at RAF Leeming in North Yorkshire personnel from one of the Royal Air Force's oldest flying squadrons regularly prepare to 'shoot down' their own colleagues in the Tornado F3, and generally make life as difficult as possible for their 'client base'. However, the motive is far from hostile, as the unit concerned is No 100 Squadron – the first to perform the 'aggressor' role in the Royal Air Force. The squadron is part of RAF Strike Command and operates a nominal strength of 19 BAe Hawks and a similar number of pilots. The unit's role is to provide a service as frontline support for other RAF squadrons as well as the Royal Navy and the British Army. With an annual allocation of 5,600 flying hours, the squadron is tasked to support a wide variety of 'users', involving frequent deployments to RAF airfields at home and overseas.

No 100 Squadron had conducted support for other squadrons for many years with the elderly Canberra, but the replacement by the Hawk T1/T1A, which commenced at RAF Wyton on 7 September 1991, heralded a vast expansion of capabilities. The squadron became operational with the Hawk on 1 January 1992, and moved to RAF Finningley on 21 September 1993. The final move to RAF Leeming took place on 25 September 1995. Despite the upheaval of introducing a new aircraft type into service and moving home twice, the duties in support of the end users have increased significantly. The latest role to be introduced is that of dissimilar air combat training (DACT) which began in September 1997, involving the simulation of various types of potential adversaries. At present this is provided for the Tornado F3 squadrons, although it should be expanded to include the Harrier, Jaguar and Tornado GR1/4 squadrons eventually. In effect the Royal Air Force has its own dedicated aggressor squadron. The limited capabilities of the Hawk restricts the simulation to that of flight parameters within acceptable safety limits, although the tactics and weapons load can be simulated effectively.

By far the largest single user of No 100 Squadron's services is No 56 Squadron, based at RAF Coningsby, providing the operational conversion unit for Tornado F3 aircrew. Training is conducted within a carefully scripted series of conversion exercises (CONVEX), each designed to become more complex as the trainee progresses towards fully operational capability. Part of the Tornado training syllabus includes realistic air defence training against dissimilar types. The Hawk is ideally suited to perform this duty as its diminutive size provides the trainee Tornado crew with a difficult target to acquire. However, while it is good training for the Tornado crew to be tested in their ability for target detection, the idea is not for the Hawk to evade completely, as all engagements are simulations. Therefore the Hawk frequently carries a small radar enhancement pod attached to the rear underside of the fuselage which assists with the signature being identified on the Tornado's Foxhunter radar. Engagements are carefully pre-planned involving personnel of No 100 Squadron flying similar 'enemy' tactics to those which the trainee Tornado crew could encounter during a wartime situation. This could involve simulating a flight of Sukhoi Su-22 *Fitter* fighter bombers armed with a particular variety of ordnance, or a pair of MiG-29

BAe

Fulcrum interceptors flying low level to penetrate the United Kingdom Air Defence Zone (UK ADZ). In each case the Hawk pilots and the Tornado crews hold extensive pre-sortie briefings, either in person or by landline. No 100 Squadron has the overriding need to ensure that Tornado crews derive the maximum training benefit from each sortie. Furthermore Fighter Controllers at RAF Buchan, Bulmer and Neatishead obtain realistic training to identify simulated enemy targets and to vector the air defence fighters while at maximum range within the UK ADZ.

The Hawk pilots are drawn from a wide variety of fast jet backgrounds, covering the air defence role and ground attack roles, and as such bring with them an invaluable wealth of experience and knowledge. No 100 squadron relies heavily on the Tornado training syllabus manual to prepare for each sortie for No 56 Squadron. Practice intercepts are carried out at low, medium and high level within designated training areas over land and sea ranging from 250 up to 40,000 ft. Following each sortie the results are debriefed by No 100 Squadron before being examined in detail with the trainee Tornado crews to evaluate all aspects of the CONVEX.

BAe

No 56 Squadron is not the only unit regularly supported, however. As well as simulating targets for practice air intercepts, No 100 Squadron switches hats and performs the interceptor role to help trainee air-to-ground 'mud movers' to reach their targets with a realistic air defence threat. This involves flying similar profiles to that which the fighter bomber crews would likely encounter in a real engagement, and would include a package of up to eight Hawks operating over a target with a tolerance of plus or minus five seconds. To enable tactics to be effective No 100 Squadron receives an input from the Air Warfare Centre at RAF Waddington, which produces updated data on the mission profiles of air arms potentially hostile to NATO.

Many of the larger NATO exercises staged in the UK and in mainland Europe involve the unique services of the Hawks of No 100 Squadron, in particular Exercises *Brilliant Foil* and *Invader*. Participation can involve deployment overseas, depending upon the role which the Hawk pilots will be simulating. The three major RAF numbered Groups are also regularly supported, in particular the frontline air defence assets of No 11/18 Group, as ongoing training for operational Tornado F3 aircrew is a major part of No 100 Squadron's function. The strike/attack forces of No 1 Group are also supported during training sorties, with the Hawk being employed to 'bounce' the fighter/bombers while ingressing and egressing their targets. No 1 Group includes the assets of RAF squadrons based in Germany, operating the Harrier GR7 and Tornado GR1, which regularly fly low level training sorties to ranges in the UK. Maritime forces such as the Tornado GR1B and the Nimrod MR2 are also included within the extensive list of users for the services of the No 100 Squadron Hawks. Slower moving battlefield types, such as the Hercules and support helicopters including the Puma and Chinook, practice defensive manoeuvres against No 100 Squadron, as the agility of the Hawk enables these squadrons to receive realistic training. This is particularly important in relation to the insertion of special forces behind enemy lines where detection would almost certainly result in the slow moving fixed-wing or rotary transport types being brought down.

The RAF Regiment Rapier Training Unit, as well as the operational squadrons have a small number of Hawk flight hours devoted to them to enable personnel manning these short range airfield defence weapons to practice against low level, fast moving, small targets. The two Sentry AEW1 squadrons at RAF Waddington, as well as the Sentry Training Flight, utilise the services of No 100 Squadron as an effective means of practising defensive measures. The Army and Navy also have a small allocation of Hawk flight hours, although most are devoted to inclusion within firepower demonstrations. Understandably senior Royal Air Force officers serving in posts at RAF Headquarters need to maintain currency of flight hours, with No 100 Squadron providing this service primarily through collecting these personnel from the nearest suitable facility. Duties such as Air Officer Commanding visits to RAF stations within their area of responsibility enable senior officers to fly the Hawk to their destination, thereby gaining the necessary flight hours while at the same time fulfilling their duties in a cost-effective and efficient manner.

BAe

To enable tactics to be effective, the squadron receives input from the Air Warfare Centre at RAF Waddington, which produces updated data on the mission profiles of air arms potentially hostile to NATO.

Amongst the many detachments made during a normal year are regular visits to Denmark, France, Germany, the Netherlands and Norway, while support of Armament Practice Camps (APC) to RAF Akrotiri, Cyprus are conducted several times annually. APC involves banner towing by the Hawks to enable Tornado F3 squadrons to practice firing the 27-mm IWKA-Mauser cannon with live rounds at a moving target. In addition the squadron detaches to RAF Coningsby and Leuchars to perform this role. Earlier in the career of the squadron the banner towing duty was a major part of the annual flying allocation, although now it is a very small, but no less important part of the mixed duties conducted.

No 100 Squadron aircrew consist exclusively of pilots with no navigators assigned as the role of the squadron is designed for single-seat operations. The squadron operates almost exclusively for the benefit of the user, with sorties generated to

Left: Hawk T1A XX352 wearing the badge of the Joint Forward Air Controllers Training Support Unit (JFACTSU). Readily visible is the radar enhancement pod attached to the underside of the fuselage. Bob Archer

meet the demands of the units to be supported. Within the confines of the overall safety of all the participating squadrons, the simulated air battles can be played out above the sparsely populated areas of northern England and Scotland. Designated routes to and from these areas enable the users to receive aggressor training for much of the time that the Hawks are airborne from RAF Leeming. The timescale and cost involved in training frontline aircrew is such that an ongoing programme has to be in place to ensure these personnel have sufficient experience to enable them to conduct their duties effectively. No 100 Squadron is ideally placed to provide an inexpensive alternative to frontline aircraft operational training being performed by the units themselves

The arrival of No 100 Squadron at RAF Leeming coincided with the commencement of a unique experiment involving the allocation of a two-year contract with Hunting Contract Services to perform all first and second line servicing and maintenance. The initial success of the venture enabled the RAF to extend the option for private venture servicing for a further three years. The civilian workforce are all former RAF personnel, none of whom left below the rank of junior technician. One of the major advantages of employing a contractor workforce is that personnel are not periodically posted elsewhere, resulting in a balanced staff who are familiar with the aircraft and need little or no training. The result is a high serviceability rate, producing as many as ten aircraft each day, with surges requiring more than a dozen at a time to satisfy as many as three simultaneous detachments. A high proportion of the 5,600 flying hours is devoted to supporting exercises, detachments and overseas deployments, with Hunting personnel accompanying these activities ensuring a high morale.

Recently acquired from store at RAF Shawbury, Hawk T1 XX219, formerly with No 19 Squadron, retains an overall grey scheme. Bob Archer

A typical mission from RAF Leeming could involve the Hawk pilots flying a simulated air defence sortie for the benefit of air-to-ground fight bomber crews, while others could be enacting the role of maritime strike as part of a training sortie for interceptor crews. In each case the Hawk pilot would fly the sortie as near possible to that which an opponent might encounter in a realtime situation, albeit with additional peacetime safety features built in. This could include flying in a dumb profile for the benefit of novice trainees, or in smart profile depending upon the type of weapons carried by the opponent. Additional profiles could involve, for example, a Tornado crew on CONVEX learning the advanced radar phase, or Combat Air Patrol within a designated 'box'. Prior to the sortie taking place all the necessary domestic issues are thoroughly briefed to ensure the participants are all fully aware of the type of mission being flown, the simulated weapons involved, and the rules of engagement. Guidelines for every type of mission profile, known as standard operating procedures (SOP), are maintained at each squadron. The SOP's provide highly detailed instructions for all personnel associated with a particular role, and include diagrams of each mission profile. Aircraft operating from RAF Marham, for example, utilise the reconnaissance SOP, while those from the two operational maritime strike squadrons at RAF Lossiemouth are guided by the maritime SOP. No 100 Squadron maintains a library of these SOPs to enable pilots simulating a particular mission to ensure they are familiar with the relevant profiles. Having established the type of mission to be flown, the Hawk pilots liaise with the other squadrons involved to finalise the sortie and to familiarise all aspects of each others brief. The type of mission flown will dictate the number of aircraft involved and the formation to be adopted, ie battle, trail, or box four card. Once the engagements commence the participants are kept busy performing evasive tactics, watching for the position of each aircraft within the training area and ensuring that safety rules are maintained. With the capability of turning at plus 9g and minus 4.5g the Hawk can be extremely agile during an engagement. Throughout an air defence engagement, the participants frequently call Fox 1 (radar missile), Fox 2 (heat-seeking missile) or Fox 3 (AMRAAM) each time they successfully lock onto a target, depending upon the type of weapon simulation. Once each engagement has been completed, the pilots break away to prepare to re-commit themselves for the next encounter. At the end of the day's planned activities, the aircraft return to their base where each engagement is subject to a thorough evaluation to ensure its effectiveness.

No 100 Squadron has one additional function to which two of its Hawk T1As are committed. The Joint Forward Air Controllers Training Support Unit (JFACTSU) has almost 600 flying hours allocated to the Squadron annually, and as its title suggests trains forward air controllers in the intricacies of directing offensive fire against ground targets while airborne. A laser receiver for ground designation of selected targets is planned to be installed to enhance accuracy. As the forward air controllers duties can be performed during day and night, the unit is also planning to utilise night vision goggles to intensify target selection. The joint Army/RAF position has two pilots and two aircraft assigned, although when not required for JFACTSU tasking the aircraft and pilots are pooled with the remainder of No 100 Squadrons assets. JFACTSU requires the deployment of aircraft to Germany three times each year for British Army of the Rhine exercises. In addition the squadrons aircraft have been involved with *Partnership for Peace* exercises alongside former Warsaw Pact air arms while operating from Germany.

The Hawk lacks a radar, and is not fitted with a radar warning receiver, which involves the pilot utilising the mark one eyeball as his most effective detection system. However, the Hawk has a GPS (global positioning system) installed which aids navigation. Most of the squadrons aircraft are painted gloss black overall, due to the majority of the Hawk fleet being painted in that particular colour to assist with detection at low level to avoid collision. Despite the appellation of 'aggressor', there are no plans to repaint any of the Hawks in colour schemes of potential opponents.

Looking to the future, the role of No 100 Squadron would seem to be assured as an invaluable, cost effective training aid for the assets of Strike Command. Aside from the need to compete against other units for the necessary annual operating budget, the single most important factor for the squadron to operate effectively is the availability of aircraft, as most of the Hawk fleet is with Personnel and Training Command. With a growing problem of the availability of Hawks for advanced pilot training at RAF Valley, there is the possibility that No 100 Squadron might be required to part with some of its allocation. Although the introduction into service of the Eurofighter is some way off at present, personnel at No 100 Squadron are already beginning to give this type consideration for the future.

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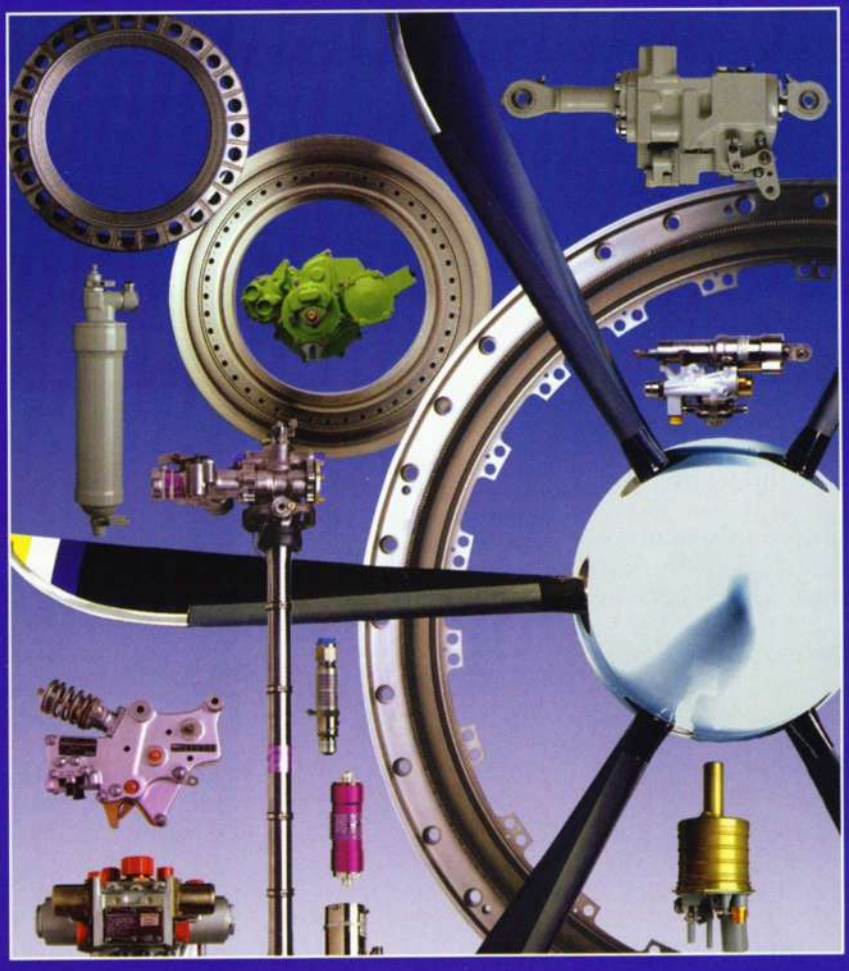

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EXPECT GREAT THINGS

Patrick Allen looks at the Rotary Wing Operational Evaluation and Training Unit (RWOETU), tasked with preparing helicopter crews to operate effectively in a multi-threat battlefield environment.

Helicopter GUNNERY AND TACTICS

A Student AGI firing the GPMG on a Puma under the guidance of RWOETU Instructor MALM Dave Coombes. All photographs Patrick Allen

It takes more than learning to fly a helicopter for RAF Support Helicopter (SH) and Search and Rescue (SAR) pilots, navigators and crewmen/women to be capable of operating effectively, and to survive, in today's multi-threat battlefield environment. New global strategic concepts and rapid deployment force structures, all now rely on helicopters to provide much of their mobility and tactical flexibility. This might entail operating independently, or as part of a joint force, undertaking a wide range of missions from peace-keeping to a full regional conflict. This broad commitment requires that RAF SH Squadrons are fully prepared and trained to undertake diverse operational tasks in any theatre of operations. More recently, the RAF's SAR Force has commenced similar training. To help prepare helicopter crews for possible missions in high air and ground threat environments, the RAF has initiated a tactics training programme to help provide the front line helicopter squadrons with a cadre of Qualified Helicopter Tactics Instructors (QHTIs) and Air Gunnery Instructors (AGIs), trained by the Rotary Wing Operational Evaluation and Training Unit (RWOETU).

The RWOETU is functionally controlled by the Air Warfare Centre (AWC) which was created in October 1993, with the aim of centralising a number of different units to help provide increased operational support for the RAF's frontline squadrons and operational commanders. The AWC comprises three main elements: Operational analysis (OA), Operational Doctrine and Training (OD&T) and Tactics and Electronic Warfare (T&EW). The Centre's Headquarters and the majority of its personnel are based at RAF Waddington, although air warfare courses are run by the OD&T at RAF Cranwell and some OA personnel are also based at Northwood, High Wycombe and Cranwell. This multi-service organisation now provides timely, integrated mission support for all air operations and is the 'centre of knowledge and excellence' for all aspects of air warfare. It is also responsible for developing new tactics and, through specific Operational Evaluation Units, for the operational evaluation of new RAF aircraft, weapon systems and equipment.

The RWOETU is responsible for operational trials of all RAF helicopters and equipment and for the development of tactical doctrine.

The RWOETU was formed at RAF Benson in April 1997 from the former SH Tactics and Trials Flight (TTF), a lodger unit with No 27 (R) Squadron at RAF Odiham, and elements of the Sea King Operational Evaluation Unit at RAF St Mawgan. The RWOETU is responsible for operational trials of all RAF helicopters and equipment and for the development of tactical doctrine and training of RAF Helicopter Air Gunnery and Qualified Helicopter Tactics Instructors (AGIs and QHTIs), who in turn, pass on their knowledge to frontline units. The RWOETU is co-located at RAF Benson with the Support Helicopter STANEVAL, both under the command of Wg Cdr Bob Tizard.

The Support Helicopter STANEVAL comprises a Standards and Evaluation Flight (SEF) and a newly-formed Medium Support

Helicopter GUNNERY and TACTICS

Helicopter Training Design Team (MSH TDT). SEF assesses the flying standards of individual aircrew and the operational effectiveness of the frontline units. The MSH TDT is responsible for course design for the Merlin HC3, which is due to enter RAF service in 2001, and for the development of new training syllabuses for the six-simulator Aircrew Training Facility (ATF) which is currently being built at RAF Benson. These simulators will be networked together to allow multi-helicopter missions to be flown and there will be scope for the Army's WAH-64D Apache simulator to be linked to the ATF for joint helicopter operational training. A wide range of training missions, including fighter evasion, heli-v-heli and electronic warfare sorties will also be possible.

Sqn Ldr Ian Rose is Flight commander of the RWOETU. He commands a dozen or so aircrew, coming from all four RAF helicopter types, Chinook, Puma, and Merlin HC3, each with a pilot, navigator and crewman, plus a Sea King HAR3/3A section with a pilot and radar operator. This small team runs an annual QHTI and AGI Course.

The seven-week QHTI course and the preceding AGI course, that took place last summer, produced a total of 18 newly qualified QHTIs and nine AGIs. These courses saw some notable 'firsts' for the RAF. It was the first time that RAF search and rescue Sea King crews had participated and included the first female student QHTI, a Sea King Pilot, Flt Lt Jane Richardson RAF. It was also the first time that a Sea King HAR3 and crew participated in the three-week tactical flying phase and the second course to fully incorporate the newly introduced tactical discipline of 'Helicopter-versus-Helicopter' (HVH) as part of the air combat manoeuvre package. A total of seven helicopters participated in the main flying phase that was located at RAF Leeming, comprising two Chinook HC2s, three Puma HC1s, a Wessex HC2 and a Sea King HAR3.

During the 1997 QHTI course the RWOETU hosted a number of official visitors and foreign representatives from other air arms who are showing interest in the Course. These included the USAF's 21st Special Operations Squadron (SOS) who provided a representative for the entire course. With more and more emphasis on joint/combined operations many NATO air arms are turning their attention towards tactics doctrines with the possibility of other nation's aircrews and helicopters participating in future RAF QHTI courses.

Many NATO air arms are turning their attention towards tactics doctrines with the possibility of other nation's aircrews and helicopters participating in future RAF QHTI courses.

The purpose of both the AGI and QHTI courses is to take suitably selected, above-average, aircrew from frontline squadrons and give them a thorough grounding in appropriate subjects and train them as instructors. For the QHTIs, the course provides an in-depth study of all aspects of tactics and helicopter survivability, defensive aids, countermeasures and weapon systems. It then shows them how to make the best use of this equipment and the tactics to operate effectively over a variety of high air and ground threat environments, both by day and by night. Both courses have gained an enviable reputation, acknowledging the value that the RWOETU has given to frontline squadrons with a cadre of highly trained gunnery and tactics instructors who are capable of passing-on and expanding tactical awareness throughout the RAF's operational squadrons.

Prior to the establishment of the RWOETU's AGI course, air gunnery and air gunnery instructing had not been fully addressed and a training syllabus had never been formalised within the RAF. Training had mainly been undertaken on an ad-hoc basis by the frontline squadrons when their operational commitments allowed. The RAF Wessex, Puma and Sea King are armed with a modified version of the standard British Army 7.62mm General Purpose Machine Gun (GPMG). This ground weapon was adapted for helicopter use by the fitting of a modified gun-mount and trigger system. Many of the weapon drills and operating procedures were taken directly from the Army's training manuals based on the weapon being operated on the ground. Most of the drills and procedures did not therefore address the problems of operating and firing the weapon from an aircraft in flight.

With the Chinook's M60D and M134 Miniguns, the latter being purchased for the Gulf War and introduced into service within weeks, things were a little better, as these Miniguns had been manufactured and used by the US Army as a dedicated air-to-ground weapon. However, once again, there was no formal training programme or syllabus for either of these weapons.

It therefore fell to the RWOETU to re-write and formalise a comprehensive training programme for all three RAF weapon systems and attempt to standardise terminology and provide as much commonality as possible in weapons drills and operating procedures for all three of them. In the near future it is hoped that a standard air-to ground weapon system, most probably based on a 0.5in/12.7mm pintle mounted machine-gun, will be used by

RWOETU Instructor Flt Lt Ian Wright gives a briefing at RAF Leeming prior to a Heli-v-Heli sortie between a Sea King HAR3 and a Wessex.

Left: Heli-v-Heli air combat manoeuvres flown by a pair of Pumas. Students are shown how to estimate firing distances of the cabin door gun and the various firing arcs.

RAF Sea Kings and crews participated in QHTI courses for the first time in 1997. This Sea King is seen at Spadeadam prior to the start of a mission.

Left: Sea King HAR3 pilot Flt Lt Jane Richardson on a Tactical Formation sortie (below left) with the Wessex undertaking a concealed approach and departure en route to Spadeadam. Below right: An RAF Chinook armed with an M60D Minigun lifts off for a gunnery sortie.

the helicopters of all three services, including the RAF's new Merlin HC3. The 0.5in gun is considered more suitable as a defensive weapon and can use a variety of ammunition, including armour-piercing and high explosive rounds and will be more effective than the 7.62mm calibre currently used.

During the AGI course, students are split into two syndicates, those on the RAF Wessex, Puma and Sea King Squadrons who will be required to instruct on the 7.62mm GPMG, and those on the Chinook, who will be instructing on both the M60D and M134 Minigun. During the two-day flying phase, which includes night firing using Night Vision Goggles (NVG) and the Ring Sight LC-40-100 NVG sighting system, student instructors are shown how to plan, prepare and conduct an air gunnery class. This is followed by dry weapons drills and a live-shoot. Sorties start with the RWOETU staff instructing the student instructors, who fire the weapon, followed by a 'give-back' with the staff instructor operating the weapon under tuition from the student.

During the range shoots, weapons can be fired in one of four standard firing profiles, devised by the RWOETU team. This allows both the instructor and the aircraft captain to know exactly what is required during each gun-run, just by stating which profile number is required. All four profiles are flown with the helicopter 300m from the target and at a height of 300ft, but at varying speeds: profile one is in the hover, profile two at 45kt, profile three at 100kt and profile four also flown at 100kt, but with the helicopter flying an approach and overshoot manoeuvre between 300ft and 800ft.

Safety is of paramount importance and is a prominent theme throughout the course. Student instructors are required to show that they have a full grasp of all the safety rules and the emergency standard operating procedures and can organise and run an air gunnery sortie with complete confidence. At the end of the flying phase, student instructors undertake a written exam to show that they have mastered all the requirements of an Air Gunnery Instructor. Having successfully completed the AGI course the majority of new AGIs subsequently undertake the QHTI course.

With the recent introduction of HVH as a tactical discipline, the importance of cabin door guns as the only defensive weapon during a helicopter attack or fighter bounce has been reinforced. AGIs are therefore given some guidance on the use of the cabin door gun in an air-to-air role.

On 11 August 1997 the flying phase of the RWOETU No 12 QHTI course began at RAF Leeming, when two Chinooks and two Pumas launched for an HVH air combat manoeuvre sortie. At the same time, a grey-painted SAR Sea King HAR3 and a Wessex HC2 took off for a tactical formation and electronic warfare sortie at the Electronic Warfare (EW) Range at Spadeadam, Northumberland. During the following three weeks daily morning and afternoon sorties were flown with QHTI students gaining one-to-one tuition on 'all things tactical'.

Some of the RWOETU staff instructors had joined the SH from fast jets. Their previous experience helped to provided a wealth of first-hand experience on how helicopters can evade fast jets during the many fighter evasion sorties which were flown against the Hawks of No 100 Squadron, Tornado F3s of Nos 11 and 25 Squadrons (all based at RAF Leeming) and Harrier GR7s from No 1(F) Squadron, based at RAF Wittering.

RAF Leeming is an ideal location for the QHTI course. It is close to a number of military training and low flying areas on the North Yorkshire Moors, at Otterburn and the Spadeadam EW ranges in Northumberland. Mission routings to and from these areas can be planned to cause the minimum of disturbance to the local communities, whilst providing excellent routes to gain maximum operational and tactical value from each sortie. During the three-week flying phase, over 200 flying hours are allocated to the QHTI course.

This course actually commenced three weeks earlier, when all 18 QHTI students

A Hawk from No 100 Squadron taxies past a Puma and Wessex at RAF Leeming. Fighter evasion sorties are flown against the helicopters, often with a Student QHTI in the back of the Hawk to get the fighter pilot's view.

Helicopter GUNNERY and TACTICS

began a series of ground school lectures at the RWOETU at RAF Benson. The ground element covers the diverse aspects and theory of ground and air tactics through which the student QHTIs gain a thorough grounding in electronic warfare, mission equipment and countermeasures etc. Lecturers include invited experts and specialists from both industry and the military, including staff from the AWC. Students are shown how to access relevant threat information from the various intelligence agencies and more importantly how to collate and assimilate all the information available and then how to plan missions to avoid known or suspected threats.

The RAF is standardising its mission equipment throughout the helicopter fleet and today, the majority of RAF frontline helicopters are fully equipped with a comprehensive defensive aids suite, weapons and electronic countermeasures. Student QHTIs gain a thorough working knowledge on all aspects of electronic warfare and various

RAF crewmen and AGIs are qualified on both of the Chinook's weapons – the M60D and M134 Miniguns.

countermeasures. They are shown the various air and ground weapon systems which may be used against them and many of the systems which are under development.

Having completed the theory, the course moves to RAF Leeming for the three weeks intensive flying phase. During the first two weeks students undertake a wide range of tactical missions, that begin with four basic disciplines: HVH air combat manoeuvres, agile Fighter Evasion (FE) and Air Intercept /Radar Fighter Evasion (AI/FE), Tactical Formation (TF) and Electronic Warfare (EW). Initial missions are 'show them' sorties flown by the staff QHTIs who instruct the student QHTIs before it is their turn to 'give back' and show that they have not only mastered the discipline but more importantly can pass this knowledge on. As the flying phase progresses, missions become more demanding and complex as increasing threats are encountered, until the student QHTIs undertake their Operational Profile Sortie (OPS) which is the final assessment of the 'Basic' Phase.

For the OPS mission, students encounter multiple ground and air (missiles/AAA) threats, are 'bounced' by fast jets and simulated helicopter attacks, and have to make the maximum use of all their defensive aids suites and newly-honed tactical skills to survive. During the OPS phase, students plan, brief and execute the missions with the Staff QHTIs acting as Limited Combat Ready aircrew. The majority of sorties last 90 minutes with the OPS lasting three hours, with many more hours devoted to pre-mission planning, briefing, debriefing and preparing written assessments after each sortie.

Most of the HVH sorties are flown against similar helicopter types (Puma v Puma/ Chinook v Chinook) with one helicopter simulating an attack helicopter. A HVH sortie begins with the QHTI Staff Instructor showing the student the ranges of various weapons system such as rockets, missiles and guns and then how to judge these distances. The next element is recognising their own aircraft's arc of fire and gun limitations before moving into combat evasive manoeuvres. These include a 'tail chase' in arrow formation, low 'yo-yo' in Battle formation, 'head-to-heads' and 'pitch-back' together with the various counter manoeuvres before moving on to the free- play evasion to counter representative enemy HVH manoeuvres.

Fighter Evasion sorties start with Agile Fighter Evasion against Hawks and Harriers. This requires the helicopters to undertake air combat manoeuvres to counter guns, rockets and infrared missiles (Sidewinders), threats requiring the students to use their countermeasures and air combat manoeuvring to help avoid the threat. The Harrier is one of the most formidable opponents for helicopters as it can slow down to match the speed of helicopters and can use their FLIR and threat identification systems to keep a helicopter in their gun/missile/bomb sights both by day or by night. For Air Intercept Radar/Fighter Evasion missions against the Tornado F3s, helicopter crews need both EW and air combat manoeuvre skills to beat this longer range missile threat. The radar warning receiver (RWR) is used to identify the type of threat (aircraft and missile system) and will tell them when they have been 'locked-on' for a missile launch. It will also tell the crew when to initiate their radar break – lock manoeuvres making maximum use of their RWR, missile approach warning, IR jammers and chaff/flares to beat the missile.

During the TF and EW sorties, helicopter pairs fly various tactical formations to the EW Range at Spadeadam. During the one-hour transit a variety of tactical formations and battle turns are demonstrated including arrow, battle, shackles, turn-abouts plus several concealed approach and departures (CADS) to simulate dropping off troops on the route to and from the EW Ranges. Students must plan and instruct during the sortie. Once at the range, staff instructors give a basic airborne EW training revision sortie covering the helicopter's Radar Warning Receiver (RWR), demonstrating the various visual and

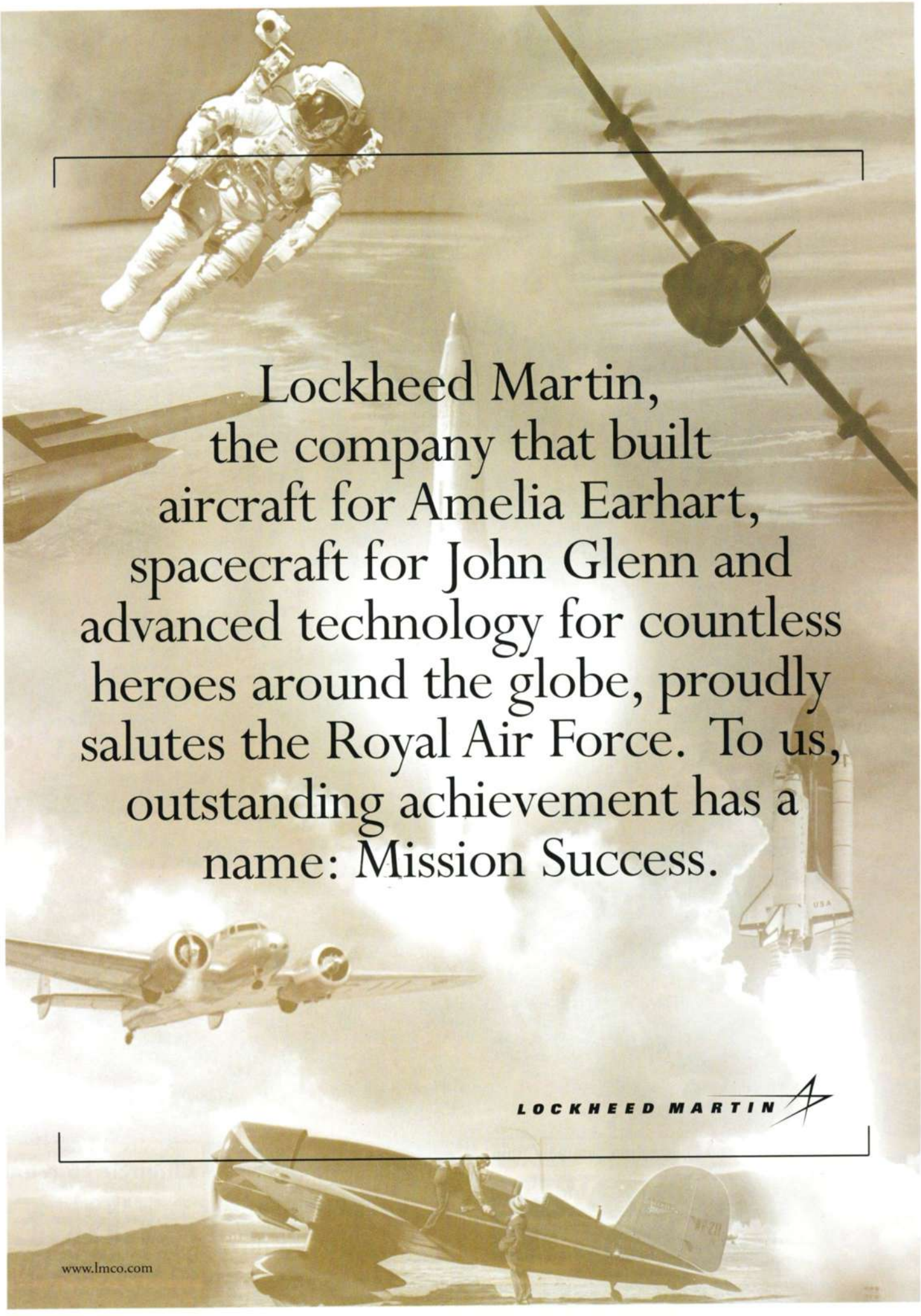
A pair of Pumas try to out-manoeuvre each other during an air combat sortie to get into a firing position on each other with their cabin-door guns.

aural tones which identify a variety of EW threats. The EW sortie also includes countermeasure tactics, including air combat and break-lock manoeuvres and terrain masking to help break an EW threat. Students must plan and brief both the tactical formations and EW phases of the sortie and deliver a detailed brief on their particular RWR system. They must also plan and co-ordinate their sorties with the Spadeadam range staff.

To provide students with experience of operating within a larger force package the course normally ends with a final Composite Air Operations (COMAO) mission giving students the opportunity to plan, brief and then take part in a major mission where they have to integrate within a larger mission package. Timings and routes must be carefully planned to avoid encountering multiple air and ground threats before completing realistic operational tasking working within the larger COMAO package which includes air defence, close air support, suppression of enemy air defence, airborne early warning and control systems (E-3D Sentry/AWACS) and troop transport aircraft (C-130 Hercules) and ground troops.

While at Leeming student QHTIs spend a great deal of time undertaking pre-mission planning, mission profiling, intelligence data gathering and planning missions to avoid known, or perceived threats and then devising routes to take advantage of terrain etc. They are required to deliver comprehensive and detailed pre and post-mission briefings. By the time the students have completed the course they have gained a thorough grounding in helicopter tactics and air gunnery and more importantly the skill to pass this on to their squadrons.

The RAF is building up a cadre of QHTIs and AGIs within its frontline squadrons, backed by the Air Warfare Centre, to provide aircrew with the support and expertise necessary to counter present and future threats, wherever the RAF Support Helicopter and SAR Forces find themselves operating.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WEAPON TESTERS

Chris Pocock visits NAWS China Lake to see how the RAF tests some of its latest equipment and weapons before putting them into service.

Carrying the Ballistic Test Vehicle (inert BL755) on its starboard pylon, Harrier GR7 ZD411 prepares to leave the ramp at China Lake. Chris Pocock

The wide, open spaces of California's high desert are fast becoming a second home to one of the RAF's more specialised flying units. Last autumn, for the second year running, the Strike/Attack Operational Evaluation Unit (SAOEU) conducted a long deployment to the Naval Air Weapons Station at China Lake, California. The main purpose: to drop three different weapons and validate their performance. The main reason: such trials cannot be effectively conducted on the UK's own small and tightly-restricted weapons ranges.

According to its outgoing commander Wg Cdr Mark Green, the SAOEU is "the conscience of the RAF". A subsidiary unit of the Air Warfare Centre (AWC) at Waddington, its work consists of trials to ensure that new combat aircraft systems and weapons do actually perform as advertised under operational conditions. Working together with specialists from the AWC and representatives from industry, the SAOEU may suggest modifications, and oversee some further development tasks itself, especially software changes. Then it will 'write the book', for example the tactics manual, on how each new piece of equipment should actually be employed by the operational RAF squadrons.

The work of the SAOEU consists of trials to ensure that new combat aircraft systems and weapons perform as advertised under operational conditions.

For instance, the unit has been trialing Night Vision Goggles (NVGs), evaluating their performance and the implications for tactics currently employed by the Tornado, Jaguar and Harrier squadrons. One of its Tornados, ZG706 named *Nightfox*, is equipped with the new FLIR which forms part of the GR4 mid-life update. The on-going Trial *Beryl* investigates the optimum use of NVGs plus FLIR, and the SAOEU has already devised a 14-sortie training syllabus to convert Tornado pilots onto this new equipment.

Such work can be conducted from home bases, but weapons tests are a different story. For instance, Garvie Island in remote northwest Scotland is the only range in the UK where 'live' 1,000 lb bombs can routinely be dropped on land. It is not instrumented, and frequent cloud cover can delay weapons tests for days, especially when release from medium altitude is required. West Freugh is the only UK range where cluster bombs can be released – with inert warheads, otherwise low-level only. Air-surface missiles can only be fired at offshore targets.

In 1996, the need to validate the new Paveway III low-level laser-guided bomb, sent SAOEU to China Lake, where in previous years the UK had already conducted the test-firings of BAe's ALARM anti-radar missile. Some other outstanding trials were also performed, and the deployment was judged a success. This encouraged the AWC to arrange for a return visit in 1997 and to plan well ahead to cover a range of future weapons trials.

A dozen or so forthcoming tasks which could best be accomplished in the desert were consolidated into a ten-week programme. In mid-September 1997, three Tornado GR1/A/Bs, three Harrier GR7s and two Jaguar GR1A/Bs left from the SAOEU's home at Boscombe Down for China Lake via Lajes, Azores and Bangor, Maine. Over 200 RAF and contractor personnel accompanied the deployment, which also involved Tornado F3s from the Coningsby-based F3 OEU and Sea Harrier FA2s from the Royal Navy. These two types were involved in electronic warfare trials and assessing countermeasures software that had been updated to meet new threats. The latter was also one of SAOEU's tasks.

The main order of business for the Boscombe Down unit was to evaluate a new version of the long-serving BL755 cluster bomb; check the performance of an improved rocket motor and new warhead on the CRV-

As well as three Harrier GR7s, the SAEOU deployment took three Tornados and a pair of Jaguars to the remote desert base in California. Peter R Foster

Right: The RBL755 in close-up. Antenna fairings for the new radar altimeter are visible on the rear fin fairing. Chris Pocock

7 rocket; and test a modified fuse for airburst attacks with the standard 1,000 lb bomb.

The nearest town to the vast China Lake weapons ranges is Ridgecrest, which grew up to support the base in the middle of the Indian Wells Valley, on the western edge of the Mojave Desert. The US Navy has been testing weapons for aircraft here since 1943, in conditions of near-perfect flying weather and unlimited visibility. The Sidewinder and Shrike missiles, the Zuni rocket, and the first 'smart' bombs were all developed at China Lake. Testing later diversified into submarine-launched ballistics missile motors, and even parachutes.

Left: Mission briefing in the ALARM building at China Lake. From left: Sqn Ldr Andy Ross, trials management officer, Air Warfare Centre; Wg Cdr Mark Green, commander, SAOEU; Flt Lt Simon Walker, weapons specialist, DERA; Flt Lt Stephen Haskins, Harrier pilot, SAOEU. Chris Pocock

Over 5,000 people are now permanently assigned here, to six different R&D laboratories, two weapons test squadrons and the highly-instrumented range complex itself. These cover 1.1 million acres, above which are 20,000 square miles of restricted airspace. "An up-market Otterburn-Spadeadam," joked Wg Cdr Green, referring to the rather more compact area of Northumberland where the RAF does much of its electronic warfare and (inert) bomb-drop training.

The RAF had 'set up shop' in a small warehouse-cum-office building in the middle of the main base area. This is still known as the ALARM building, a reference to its previous occupants, and it is actually owned by the UK. A briefing room contained a portable Mission Planning System (MPS), video debrief equipment for the three types of aircraft deployed, and another four-screen system for electronic warfare analysis. Elsewhere in the building both desk and storage space was tight, but at least the building was conveniently situated in relation to Range Control – which was just across the street. The eight aircraft were parked on a small ramp some distance away, on the opposite side of the runway from China Lake's own large test fleet of F/A-18s, AV-8Bs and assorted other types.

The new RBL755 was the main focus of attention on the day of my visit. The original BL755 was designed by Hunting Engineering in the early 1970s to meet the requirement for a weapon that could be released at low level to destroy a mix of small hard and soft targets, such as armoured and supporting units on a battlefield. Weighing 600lb, it consists of a finned casing which covers seven bays, each of which houses 21 bomblets. After leaving the aircraft, a gas cartridge fires to release the two-part casing, and another cartridge then fires to eject the 147 bomblets at varying speeds, so that an even dispersion along the ground is achieved. In response to the increasing thickness of armour on the fighting vehicles of the Warsaw Pact, improved bomblets were introduced in 1987 with better warheads and mini-parachute retarders to give a higher impact angle.

Then came *Desert Storm*. Thanks in part to the low-level attacks conducted by RAF Tornado GR1s on Iraqi airfields with the JP233 weapon, the Allies quickly gained command of the air. A significant portion of Iraq's command-and-control and medium/high-altitude surface-to-air missile capability was also destroyed during the opening days of the war. Subsequent air raids could therefore be conducted at medium rather than low altitude, giving greater protection against the remaining SAMs and anti-aircraft artillery, many of which were low-level systems attached to armoured formations. Indeed, Iraq's huge armoured forces were now a priority target, but RAF fighters were unable to use BL755 to attack them from higher altitudes. The weapon was activated by a short-duration timer, suited only to low-level release. The Jaguars which flew in Operation *Granby* had to be hastily equipped with American Rockeye cluster bombs instead.

The MoD eventually decided to modify some existing BL755s for release at medium altitude by fitting a radar-altimeter to the rear casing – hence the addition of the prefix R to the weapon's designation. This would initiate the firing sequence as the weapon neared the ground. But to what extent would the weapons-aiming solutions which had previously been computed for BL755 have to be modified for the new conditions? What would be the effect on the weapon's ballistics, of the extra drag induced by the radar altimeter antennas?

On the day of my visit, the SAOEU would be finding out some of the answers, during two Harrier GR7 sorties. Sqn Ldr Ross would fly ZD411 (callsign *Striker 1*) at 15,000 ft and drop a single RBL755 in a wings-level attitude. Then Flt Lt Walker in ZG501 (*Striker 2*) would drop a stick of four from a similar altitude, but in a 20-deg dive.

The pilots assigned to SAOEU must be experienced, and have a tour as a weapons or electronic warfare instructor behind them. Some of the supporting officers have similar backgrounds, or are career scientists. On this occasion, the key ground-based roles were played by Sqn Ldr Andy Ross, a trials management officer from the AWC, and Flt Lt Simon Walker from the Defence Evaluation and Research Agency (DERA), who was charged with obtaining the final clearance for RBL755 to be carried by military aircraft.

Together with liaison staff from the Naval Air Warfare Centre Weapons Division who had been assigned to the British team for the duration of the deployment, the four RAF officers sat down to brief the mission. The target had been set up on Airport Lake, a dry lakebed 15 miles north of the main base area, close to high ground which marks the northern end of Indian Wells Valley. At the centre of three concentric circles painted on the lakebed, with an outer diameter of 300 ft, the SAOEU had placed a black sheet, a 'commercial off-the-shelf' acquisition from the local K-Mart! "The contrast between the sheet and the lakebed will help the Harrier's dual-mode tracker lock-on to the target," noted Wg Cdr Green.

After downloading data from the MPS into their data storage cartridges, otherwise known as 'bricks', the two pilots departed for the flightline. Sqn Ldr Ross and Flt Lt Walker strolled over to Range Control, and seated themselves at one of four consoles in one of the well-equipped control rooms. The others were occupied by range control staff, while casual onlookers were accommodated behind a glass partition. The far end of the room was dominated by a giant screen surrounded by four smaller screens, all displaying scenes from various parts of weapons range

Bomblets separating from a BL755 canister as it nears the ground. Hunting

'George', relayed from five video cameras by microwave links. These and four co-located high-speed 35mm fim cameras would use kinematic techniques to track the aircraft and weapons in flight, to accuracies of a few feet. A further four video cameras would cover the impact area, and four more high-speed film cameras would also follow the weapon during its final descent and impact. In the terminal phase, the latter would be running at 1,500 frames-per-second – fast enough to exhaust the film magazine in only 10 seconds! Its operation was therefore computer-controlled.

On the flight line, the two pilots inserted their 'bricks' into the Harriers' mission computer, and carefully checked their weapons fit. *Striker 1* carried its single RBL755 under the port wing, on the middle of the three outer pylons routinely used for weapons (the innermost pylon held a 250 gal fuel tank. An inert BL755 painted black and white (and officially known as a Ballistic Test Vehicle – BTV) was hung from the corresponding pylon of the starboard wing for counterbalance. *Striker 2* also carried the big tanks, with the four RBL755s on the two outermost pylons each side.

After an uneventful takeoff and climb, *Striker 1* soon checked in with Range Control. After a few dry runs, Flt Lt Haskins returned to his initial point, flew back towards the target and was 'cleared hot' by Range Control. But the pilot soon reported 'off dry' with no weapon dropped, having failed to identify the range circles. From his console, Flt Lt Walker explained that in a straight-and-level drop from this altitude the Harrier pilot is unsighted, and will use the aircraft's Angle Rate Bombing System (ARBS) to drop his weapons automatically. This requires him to identify the target from his Head-Down Display, which carries imagery from the television camera in the nose-mounted dual-mode tracker. (Laser is the other mode – not required in this case – with either mode providing range-to-target calculations for the ARBS). But *Striker 1* was not equipped with the GPS-aided inertial navigation system which would ensure the camera was pointed towards at the target.

Another run was set up, and this time Flt Lt Haskins managed to cue the display and lock-on with the TV camera. Separation of the weapon was clearly displayed to those in Range Control by the powerful tracking cameras. After about ten seconds of momentum-induced forward flight, the canister's trajectory assumed a somewhat more vertical path, but it still seemed a long time before the casing split at the advertised 1,000 ft above ground. "Don't forget there is a three-and-a-half mile forward throw involved, so the total distance travelled by the weapon dropped from 15,000 ft is actually 21,300 ft," advised Flt Lt Walker.

The bomblets emerged, and soon impacted the target area as a myriad of small explosions. Two larger puffs of dust puzzled the observers for a moment, until Flt Lt Ross realised that these were caused by the two halves of the bomb casing falling to earth. He made a quick calculation of the weapon's dispersal. He had been expecting a roughly 100 x 120 ft pattern, and seemed pleased with the result.

Separation of the weapon was clearly displayed to those in Range Control by the powerful tracking cameras.

So far, so good. *Striker 1* now performed further dry runs over the target area, using the 20-deg dive which *Striker 2* would soon employ to drop the four-stick. "The Boss will be travelling at near maximum TAS (true air speed). We're checking that the aircraft's computer release calculations are correct," explained Sqn Ldr Ross. This is known in the trade as a Release Point Assessment (RPA), which is done by the aircraft generating a radio tone, which ceases at the point of simulated weapons drop. The range tracking data is then analysed to confirm that the aircraft is exactly where it should be for weapons release.

'The Boss' checked in by radio, and with fewer preliminaries this time, was soon running in for the four-stick drop. This too, was clearly viewed from Range Control, including the larger impact area on the lakebed – the same 120 ft width as the single drop, but about 700 ft in length. It looked spectacular from our vantage point, but anyone in the line of fire would no doubt have thought otherwise! Wg Cdr Green later explained that he had been aiming for an 800 ft-long pattern, but higher-than-expected winds over the target area had made the difference.

With both aircraft safely back on the ramp, the post-flight analysis began. The officers and the scientists would be checking the weapons-aiming solutions, and evaluating the weapons effects. This is detailed, painstaking work. The Harrier GR7 has a composite wing, and as one officer noted, a small extra degree of upwards flex upon weapons release by that wing, could reduce the separation velocity and throw out all subsequent calculations.

Out on the lake-bed, meanwhile, the RAF was helping to clear up its own mess. According to Flt Sgt Borrett from 5131 (Bomb Disposal) Squadron based at RAF Wittering, a number of the bomblets from a BL755 drop are likely *not* to explode. Therefore, the search was now on for an unknown number of unexploded bomblets from the morning's aerial activity. Together with personnel from China Lake's resident EOD unit, the Flt Sgt and his team would spend the rest of the day traversing the lakebed in an M48 tank with gun barrel and upper turret removed, allowing more sets of eyes to survey the target area for the offending weapons.

On other days during this deployment, the SAEOU fired CRV-7 rockets from Jaguars to determine whether the different burn rate of the new rocket motors had implications for weapon aiming, and to check the effectiveness of the new Kinetic Energy Penetrator (KEP) warheads.

Tornados used new software to deliver airburst 1,000 lb bombs from 300 ft at 500 kt in level, five-degree and ten-degree attitudes. The task was to revalidate the bomb fuzes and assess whether this tactic would be more effective against (for instance) SAM sites. More 1,000 lb bombs and BL755s were dropped from the Harriers as the SAEOU explored a revised HOTAS functionality and the effect of new software in the aircraft's weapons computer.

The unit also flew after-hours, to assess the effect on NVG/FLIR assistance on the darkest, no-moon nights. In the UK, due to the dense population, there is always a degree of ambient light from street or house illumination. Around China Lake, there's no-one and nothing! The RAF is already planning its next deployment...

Cameras on the range record the scene as bomblets from the RBL755 rain down on the dry lakebed as *Striker 2* finds the target.

This modified tank is used to clear unexploded weapons on the lakebed range. Chris Pocock

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ARCC

AERONAUTICAL RESCUE CO-ORDINATION CENTRE

David Donald looks at the work of the Aeronautical Rescue Co-ordination Centre (ARCC) at RAF Kinloss, to which all UK search and rescue co-ordination duties have been transferred.

Alongside the *Red Arrows*, the RAF's rescue forces are the 'public face' of the service. The distinctive yellow Sea Kings (not forgetting their Navy and Coastguard cousins) regularly feature in the news or 'real-life' drama programmes, performing daring rescues, while the word 'Nimrod' is often heard in reports of searches for wayward vessels. Yet the work of the Aeronautical Rescue Co-ordination Centre (ARCC) at RAF Kinloss in the north of Scotland goes largely unsung. It is this facility which is the linchpin of the whole UK search and rescue (SAR) effort, providing the rescue forces with all of the notification, information, co-ordination and support they require to perform their often daunting, yet ultimately richly rewarding tasks.

A co-ordinated SAR organisation was first established in February 1941. The heavy wartime training effort for aircrew resulted in many accidents, yet SAR was only undertaken on a piecemeal, local basis, with no national vehicle for co-ordinating searches. The sad result was the loss of many aircrew who had survived the crash, but who could not be found in time to be saved. With the introduction of a national organisation under the Director-General of Aircraft and Aircrew Safety, the number of successful rescues rose dramatically, and by the end of World War 2 8,000 airmen had been saved, plus 5,000 other servicemen and civilians.

To co-ordinate the rescue effort, UK airspace was divided into two regions, and two ARCCs were established. One was at Plymouth (operated by the Royal Navy) and the other was at Pitreavie Castle in Scotland, manned by the RAF. The SAR role rapidly became an important part of the RAF's overall tasking and continued thus after the war's end. In 1955 the effectiveness of the force was greatly enhanced by the adoption of Whirlwind helicopters, and the creation of two squadrons (Nos 22 and 202) to operate them. In early 1996 the RAF's ARCC moved from its underground bunker at Pitreavie Castle to a modern, purpose-built building at RAF Kinloss. It began to prepare for the most dramatic upheaval that the rescue forces had undergone since their inception in 1941.

At midday on 1 December 1997, the ARCC-UK formally stood up at Kinloss, assuming all of the rescue co-ordination duties for the whole UKSRR (UK Search and Rescue Region). The region covers approximately three million square miles and encompasses the area from near the Spanish coast (45 deg N) to near the Faroes, and from the median of the English Channel out to mid-Atlantic (30 deg W). Within that region Ireland maintains its own SRR over its land mass and coastal waters, out to 15 deg W. The Plymouth RCC continued to operate until 12 December, ensuring a smooth transition, but once it had closed Kinloss became the sole centre for all aeronautical rescue operations. The Coastguard operates Maritime RCCs to co-ordinate the maritime rescue operations of its own vessels, four S-61 helicopters and the RNLI lifeboats.

What enabled Kinloss to take over the entire UKSRR responsibility was the introduction of the RCS (Rescue Co-ordination System), an integrated computer system which was installed during 1997, going 'on-line' at the end of September. Devised and installed by Data Sciences UK Ltd, the RCS combines COTS (commercial off-the-shelf) equipment and bespoke software to provide the ARCC controllers with a powerful support system which gives rapid access to a large database, and which automatically logs the progress of each rescue.

Prior to the installation of the RCS, the ARCC operated by means of handwritten logs, while essential information such as asset/tasking locations, and asset readiness states, was presented and monitored by the use of wall boards and maps, with magnetic markers. Some computer databases were available, but these were not integrated into an overall system. The 'old' equipment worked perfectly well, as evidenced by the countless lives saved over the years by the SAR force, and the maps, readiness boards and paper forms are retained just in case the unlikely happens, and the computer system fails.

Why was there the need for a new system? The answer lies in the ability of the RCS to enhance the effectiveness of the rescue controllers, with the result that response times are even quicker. In many circumstances minutes count: medical research has proven beyond all doubt that there is a 'golden hour' after traumatic injury. If accident victims can receive treatment within that time, their chances of survival are far higher than if they do not. Furthermore, the RCS increases the capacity of the ARCC by making it easier for each controller to run several taskings simultaneously.

Anatomy of the ARCC

Physically, the ARCC building is centred around the control room, which has 14 controller stations. It also accommodates the UKMCC, the satellite distress beacon facility. Attached is the HF communications room and various administration rooms. The main computer system requires a dedicated room for the powerful server which is the heart of the RCS. The principal ARCC has an alternate site (another building at Kinloss a few yards away) which is equipped with six controller stations. In the event of a failure in the primary site, the controllers can 'de-camp' to the alternate within minutes and continue their jobs. Electronically, the alternate is a mirror-site of the primary, and the two are linked by

The rescue of two teenage boys from rocks off Morwenstow, Devon on 21 May 1997, by a new RAF Sea King HAR3A of 'A' Flight, No 22 Squadron from RMB Chivenor. R L Ward

The Sea King is the workhorse of the SAR fleet, serving at six UK locations with Flights of Nos 22 and 202 Sqns, supported by No 203(R) Sqn at St Mawgan, the Sea King OCU. David Donald

dual-redundant fibre-optic land-lines. The alternate has its own server, which is updated at the same time as the primary site.

For long-range communications with the SAR forces, HF radio is used, requiring a dedicated room and operators. The standard military HF transmitters are used, although the ARCC has its own emergency transmitter. By its nature, using HF radio is a 'mysterious science' which requires a specialist operator. In the future it is hoped that the Sea King helicopters will be equipped with satellite communications, which will greatly enhance the ability of the ARCC and helicopter to stay in contact. Satcoms 'data-bursts' will allow the ARCC to pass information in printed form, which is easier for the Sea King's navigator to interpret than voice messages over the HF system. On the other hand, satcoms will allow the Sea King to transmit its precise location (taken from GPS readings) back to the ARCC, allowing the controller to monitor the helicopter's progress and support accordingly.

Each of the 14 controller stations comprises a two-screen terminal for the RCS and a communications sub-system. The latter consists of a single telephone attached to a touch-sensitive screen upon which are displayed various squares corresponding to telephone numbers. The communications database contains every number the controller may need, including hospitals, police forces, coastguard organisations and many others. Naturally, the bases of the dedicated SAR assets are available, including the all-important red-coloured 'scramble' lines. The latter are connected to the ARCC by secure ISDN lines to ensure that communications are uninterrupted by the everyday vagaries of the telephone system. The screen is menu-driven, allowing the controller to call up any of a number of categories from the system. A touch on the screen highlights the required

Left: The large object is a typical 406 marine beacon, activated on contact with water. The small unit is a search and rescue transponder (SART), which provides homing information when illuminated by a search radar. David Donald

In the future it is hoped that the Sea King will be equipped with satellite communications, which will greatly enhance the ability of the ARCC and helicopter to stay in contact.

number, and a further touch initiates the call. Incoming calls flash up on the screen, accompanied by an audible warning, and are annotated with the caller's identity.

Alongside the comms screen are the two large screens for the RCS, consisting of a logging screen (centre) and a map display (right). The logging screen is where the controller inputs information to the RCS, beginning with the initial logging of the incident, through records of 'phone/fax messages during the incident to the product of an incident summary. All actions are recorded on the main server, annotated with precise time information. This allows ready access to unalterable information if any inquiries arise from the incident. Displays from either the logging or mapping displays can be projected on to large wall screens for monitoring by larger numbers of personnel.

A view of the ARCC showing some of the 14 terminals. Note the overhead projector for putting up large displays on the wall screens. In the background is the HF communications room.

The ARCC at work

Notification of incidents comes through three channels. The Coastguard is the responsible agency for all maritime incidents, while the police are the responsible agency for land incidents. Notification of missing aircraft usually comes from the Distress and Diversion facilities at Heathrow and Prestwick, or through the military communications network. 'D&D' may also provide notification of distress beacons detected by high-flying airliners.

Calls come through via the communications suite, and are immediately entered into the RCS log by the controller. The RCS has a geographic database consisting of two map bases, one a 1:50,000 Ordnance Survey map and the other an air navigation chart, with various overlays of key locations. The system can handle latitude/longitude co-ordinates or National Grid references, and also has a gazetteer consisting of every geographical feature or habitation named on the OS maps. By simply typing in the name given in the alert call, the system can come up with the list of locations with that name, and once the correct one has been established, a map comes up on the mapping screen, with a marker for the location. A zoom function allows the controller to view the map in many scales so that he or she can determine which is the closest asset available. The mapping screen can have several displays, perhaps one with a large-scale map of the incident location and another small-scale map of the general area. Alternatively, an air chart can be shown.

Assets directly controlled from the ARCC consist of the SAR helicopters, which are

Above: A single Nimrod MR2 from the Kinloss Maritime Reconnaissance Wing is held on one-hour alert for SAR scrambles at all times. The aircraft carries pre-loaded, air-droppable ASR equipment in its weapons bay. Peter R March

strategically located around the coast. RAF Sea King HAR3/3As are based with flights of No 22 or No 202 Squadron at Lossiemouth, Boulmer, Leconfield, Wattisham, Chivenor and Valley, while the Royal Navy maintains SAR-dedicated Sea King HAR5s at Culdrose and Prestwick. Filling the gaps are Sikorsky S-61Ns operated in single-aircraft detachments by the Coastguard at Lee-on-Solent, Portland, Stornoway and Sumburgh. These helicopters, operated by Bristows under contract, have the disadvantage of being bound by CAA safety regulations, which does not allow them to fly in the same bad weather conditions in which military machines can operate. The ARCC also has direct control over the military Mountain Rescue Teams (MRTs) based at Kinloss, Leuchars, Leeming, Stafford and St Athan, and a SAR-dedicated Nimrod on alert at Kinloss. The readiness state of each asset is constantly updated by the RCS and can be called up instantly by the controller.

Which asset to launch is primarily a function of distance and the nature of the incident. However, weather can be a major factor, either at the helicopter's own base or for en route navigation. For instance, it may be quicker to launch a Sea King from Valley to attend an incident in the Lake District if there is a strong south-westerly wind than it would be to launch one from Boulmer, which is closer, but which would require the Sea King battling a headwind all the way. Icing is a major factor in helicopter operations, for the Sea Kings cannot operate in the conditions that are often encountered in mountain rescues. In such cases a helicopter may be used to transport an MRT as high as possible up the mountain before entering the icing zone.

The ARCC controller can also employ assets from outside the SAR organisation, although the release of these has to be requested from their own controlling authorities. The RAF's Chinook helicopter, for example, has much greater range than the Sea King, and can lift a far greater load. It has obvious applications in a large-scale disaster.

Pinpointing the location of the incident is often half the battle, and the RCS has a number of 'smart' features to aid the controller. These include functions which will compute a parachute drift from a known ejection point, theoretical gliding distances for powerless aircraft, and sea drift. Searching for lost aircraft and ships is one of the hardest tasks because of the huge areas that can be involved. The co-location of the MCC and its monitoring of SAR beacons can ease the task.

For aircraft searches, the ARCC employs a variety of complementary methods, including ground reports, seismic sensors and radar replays. The controller, via the RCS, can call up air traffic radar playbacks to review the last known position and track of the missing aircraft. If it is thought that the aircraft has crashed in a certain area, the controller can examine the records of seismic sensors, which will often detect the impact. These do not give any directional information, but if a group of sensors show impacts at the same time this can narrow the area that needs to be searched. The locations of these sensors is one of the overlays available for the map display. Operational schedules for the RAF's AWACS force are also supplied to the ARCC, and the Sentries are occasionally called upon to operate in support of airborne emergencies when available.

Coastguard helicopters provide SAR cover from Lee-on-Solent, Portland, Stornoway and Sumburgh, with Bristow operated Sikorsky S-61Ns. Peter R March

Sea searches are more difficult as there are fewer clues. It is in such instances that the SAR-dedicated Nimrod comes to the fore. Held at one-hour readiness, although usually airborne in much less time, the Nimrod is well equipped for maritime searches across wide areas of ocean. Its Searchwater radar, designed to detect snorting submarine periscopes, can easily pick up small vessels, liferafts or wreckage across a wide radius and in high sea states. In its weapons bay the SAR Nimrod carries ASR (Apparatus, Sea Rescue) equipment, comprising air-droppable liferafts. Each ASR has three automatically inflating liferafts connected by lines. Once the vessel has been located, the ASR kit can be deployed if required, dropped upwind of the vessel so that it drifts towards the vessel. The connecting lines mean that some part of the ASR kit may probably be snagged by the vessel. Nimrods also provide important 'top cover' for the helicopters on overwater rescues, by providing communications relay and accurate navigation directions. This keeps transit times to a minimum, an important consideration when a rescue is being undertaken at the limit of the

Above: In January 1998 the FV *Sonia-Nancy* got in trouble in the Atlantic. A Nimrod dropped ASR liferafts, two of which were drawn to the side of the trawler by the crew. Later in the rescue attempt, having secured a line to the trawler, a Sea King moves in to put the winchman down to begin the retrieval of the crew.

Sea King's radius.

Throughout any search or rescue attempt, the ARCC controller remains in contact with the SAR vehicle by means of HF. Although the comms system allows the controller to talk direct, it is general practice for the controller to send typed messages through the internal RCS to the dedicated HF operators. Similarly, the HF operators listen to the signals from the SAR helicopter or Nimrod, and convert them into simple messages which appear on the controller's screen, allowing the controllers to concentrate on the co-ordination of the task.

Maritime and air operations often require co-ordination with bordering rescue regions of other nations. The comms suite has direct lines available to all of the bordering RCCs so that rapid co-ordination is achieved, or diplomatic clearances obtained, where necessary. This often involves Ireland, as the UKSRR extends well beyond the Irish rescue region and it is not uncommon for RAF Sea Kings and Nimrods to fly through Irish airspace on their way to rescues in the Southwest Approaches. Indeed, Sea Kings often use Irish bases on the west coast to refuel.

Throughout the rescue operation the controller maintains regular contact with the alerting agency and other rescue assets being deployed (these may include civilian mountain rescue teams, air ambulances, fire brigades, police helicopters and ambulance services). Using the RCS the controller can also command a TDA (temporary danger area) for air traffic around the incident location.

Once the survivors have been successfully picked up, the full value of the RCS becomes immediately apparent. On the base map showing the incident location can be overlaid displays of the nearest hospitals, including those with specialist facilities. The locations of hyperbaric chambers can be overlaid to show the controller where to send victims of diving accidents. With these overlays the controller can immediately see what is the best option for the survivors, and instruct the helicopter crew immediately. Another useful planning function is a distance-measuring cursor which can be used on the map display in any scale.

All of the controllers have a SAR background and this experience is of inestimable value during the search and rescue missions.

Once the survivors are on their way, the ARCC will alert the relevant hospital to the impending arrival of the helicopter, the basic details of injuries and the expected time of arrival.

All of the controllers have a SAR background – in helicopters, ATC, Nimrods or MRTs – and this experience is of inestimable value during the search and rescue missions. Although it is the actual crews who fly the missions who have the final responsibility for planning, the ability of the ARCC controllers to assess the situation beforehand and apply their own experience greatly eases the job of the SAR crew. Controllers work on a 12-hour shift basis, with four days on and four days off. The ARCC provides a 24-hour, 365-day operation, but is only partially manned. In the event of a major incident, or series of incidents, off-duty controllers can be rapidly brought in to man spare terminals to increase capacity.

The primary task of the ARCC and the dedicated SAR forces is the provision of SAR to the military, but this now only accounts for about five per cent of their activities. The remaining 95 per cent is generated by the civilian authorities. In addition to the SAR missions, the rescue forces also undertake 'Military Air Aid to the Civil Community' operations, these including the airlift of supplies during periods of extreme weather and other support missions. Many of these missions are catered for from the allocated training budget. The helicopter force is also available for medical evacuation or rapid organ transfer flights at the request of the health authorities. All such requests are channelled through the ARCC and as many are responded to as possible, given aircraft availability and other ongoing incidents.

At the current rate the ARCC scrambles SAR assets on about 2,000 calls annually, of which about 1,500 result in actual rescues. The service is free to the user, yet to the stranded yachtsman, fallen climber or force-landed pilot it is worth the most precious gift of all. Since 1941 Britain has enjoyed the most comprehensive and efficient SAR service of any nation – the new-look ARCC-UK and its associated MCC will ensure it stays that way for many years to come.

Island in the sun

Peter R March visits RAF Akrotiri, Cyprus.

In early October 1997 the world's media reported the dramatic rescue of the 487 passengers and 186 crew from the stricken liner *Romantica* some fifty miles south of Cyprus. No-one was injured in the evacuation despite the fact that the ship was well-ablaze, listing badly and in danger of sinking, when the last of the crew and captain were lifted off by one of the two Wessex HC2s of No 84 Squadron involved in the rescue. Speaking later of the RAF involvement, Akrotiri's station commander Gp Capt David Williams said: "It was a very professional performance and exactly what I would have expected of the Squadron. I am very proud of the way the station worked together as a whole; very co-ordinated and professional."

'A well co-ordinated team working very hard', aptly sums up the impression that a visitor gets after a look at the varied demands, stresses and strains and routine work of RAF Akrotiri. Located in the western Sovereign Base Area of Cyprus, the 18 square miles of the air base, some 2,500 miles from Britain, is home to around 3,000 Britons, including 700 RAF personnel and their families. Although only one squadron, No 84 with five Wessex helicopters, is permanently based here, during the course of a year aircraft from most RAF operational squadrons and many training units pass through or stay for extended periods of training. The air-to-air range located a few miles south of the Akrotiri peninsula is used by fighter squadrons on armament practice camps and the good weather and uncluttered airspace is put to good use by the *Red Arrows* for its pre-season work-up in April each year.

"The success of Operation *Granby* in 1991", in the words of the Chief of the Air Staff, "would have been impossible, had it not been for this little scrap of Britain in the eastern Mediterranean". Since the Gulf War, Akrotiri's 9,000ft runway has seen extensive traffic involved in Operations *Warden* (Turkey) and *Jural* (Saudi Arabia) and more recently with Operation *Barton* (Kuwait and the aircraft carriers *Invincible* and *Illustrious*) as the Iraqi regime thwarted the work of the UN weapons inspectors and played its dangerous game of brinkmanship. RAF Akrotiri has long been involved with providing support to the United Nations and today, No 84 Squadron assists the UN forces manning the so-called 'green line' separating the Greek-Cypriot and Turkish-Cypriot communities. It also accommodates a permanent detachment of US Air Force Lockheed U-2 aircraft that fly on daily UN reconnaissance missions and a US Embassy Flight of UH-60 Blackhawk helicopters.

Having returned to the island where he had been educated and married and had now completed his first year as station commander, Gp Capt Williams commented last November that the most noticeable thing he had discovered was that every day is significantly different: "Some are predictable while others are quite unexpected in what they produce. Take yesterday for example. Being a Sunday the airfield was, according to the monthly schedule, planned to be closed. But because there was a 'trail' of Jaguars and attendant tankers heading for Thumrait, 20 inbound aircraft were received and turned round between 6.00 and 11.00pm. Their crews were fed and accommodated overnight and all the planning carried out for an early departure this morning. Akrotiri has handled nearly 1,500 aircraft this year that brought some 50,000

Blazing liner rescue

Akrotiri crews lift passengers to safety

TWO Wessex helicopters from Akrotiri-based 84 Squadron were involved in the dramatic rescue of passengers from a blazing cruise liner near Cyprus.

Right: The liner *Romantica* burning fiercely off the coast of Cyprus, viewed from the approaching Wessex of No 84 Squadron.
RAF Akrotiri

Left: RAF Akrotiri forms the backdrop for No 84 Squadron Wessex XV730. Peter R March

Although Akrotiri is the biggest RAF base in terms of real estate anywhere in the world and is among the most important, its organisation is very different. There are only two of the normal RAF station wings – Operations and Administration – the rest of the structure comprises lodger or detached units. The Princess Mary's Hospital, for example, commanded by Gp Capt Simon Dougherty, RAF, is now run by the Defence Secondary Care Agency. It is the sole remaining military hospital dedicated to treating servicemen and their families and has become fully tri-service in every respect.

In total, Akrotiri has one of the smallest cadres of RAF uniformed personnel, and its day to day organisation and activities are far from typical. In fact you are just as likely to see an Army uniform at Akrotiri as an RAF one, since many of the support services have been rationalised, while in the offices, stores and workshops an equal number of civilians can often be found. The Cyprus Engineering Unit (CEU), under the command of Wg Cdr Graham Dyson, with its Engineering Support Squadron, a Force Workshop Company and a Calibration Centre has 200 RAF, a similar number of civilian and 40 Army personnel on strength. On the other hand, the Cyprus Logistics Unit (CLU), commanded by Lt Col P S Bennett RLC, has 150 Army, 90 RAF and over 400 civilians employed for its wide-ranging support functions. These include the provision of supplies, postal services, catering support and transport for all units across the whole island. A unit of the Royal Logistics Corps operates a variety of vessels for patrols around Akrotiri's long coastline.

The picture was very different back in the mid-1950s, after the loss of our airfields in the Suez Canal Zone and the changing political balance of the area. Responding to the emerging need to have squadrons of reconnaissance, interdiction and counter-strike aircraft located at the gateway to the Middle East, the first 30 RAF personnel were posted to Cyprus on 1 July 1955, to establish an airfield on the flat, dry, rocky and uninhabited scrubland near to the village of Akrotiri. Although there had been a military presence in Cyprus since it became a Crown Colony in 1925 and the RAF had an airfield at Nicosia, it was decided that this was not big enough to house such a major force.

By 1 October the new site was officially named the Near East Air Force Strike and Reconnaissance Base Akrotiri and its first CO was appointed the following month. As reported at the time, it was 'just like a shanty town from the Klondike', with very primitive conditions while the buildings, roads and first 1,500 yd of runway was constructed. On 16 January 1956 a Hastings transport landed, bringing an advance party of No 13 Sqn, marking the opening of flying operations. By 22 January a further 500 yd had been laid, enough to permit AVM G D C Boyce to bring in the first of 13 Sqn's ten Meteor PR10s from Abu Sueir. These were progressively replaced by Canberras from May 1956. In the following two months No 208 Sqn arrived with Meteor FR9s and No 6 Sqn flew in with Venom FB4s.

The Suez Crisis brought about a massive expansion at Akrotiri, with over 3,000 personnel on the station by the end of August. Two Hunter F5 squadrons arrived from Tangmere and in the next two months the French Air Force sent F-84 Thunderstreaks to the base. From 1-16 November, the station played an important role in the armed conflict

Above: A No 84 Squadron Wessex passes near the Roman amphitheatre at Curium, a popular tourist destination on the island.

Right: Crews of No 84 Squadron have regular winching exercises with vessels like this RN landing craft. Photographs Peter R March

passengers through the air terminal, together with 4,000 tonnes of freight and baggage. The airfield is established to be open on weekdays from 7.00am to 7.00pm, with a further 20 hours a month allocated for weekend opening. For much of the year and especially since September, the requirement for weekend flying has been upped to four times this figure".

Gp Capt Williams said that he had concerns about the pressures this put upon personnel. "Since the *Options for Change* review there has been greater investment in Cyprus and our operations have become more cost-effective. Although our commitments have been extended as a result of action in the Gulf, for example, our manpower allocation has not been changed to meet the increased tasking. This has placed a heavy burden on some of our service personnel, especially the RAF Police and the air movements staff".

Left: The Air Traffic Control staff at Akrotiri handle a wide variety of aircraft, ranging from Tornados and U-2s to helicopters and light aircraft from the based flying club .

Below: A VC10 of No 10 Squadron disgorges its passengers after one of the regular twice-weekly flights from Brize Norton.

Bottom: A visiting Tristar K1 of No 216 Sqn departs Akrotiri ahead of a pair of Jaguars that it was 'trailing' to Thumrait last November.

Photographs Peter R March

with Egypt. But by the end of the year and the final evacuation of Port Said things returned to normal, but on a very different scale. The station had five resident flying squadrons, three regiment squadrons, a maintenance unit, a hospital and the number of personnel had risen from 267 to 3,139.

Over the following 40 years RAF Akrotiri has continued to maintain its key role in British defence policy and supporting the work of CENTO, NATO and the UN in the area. At the same time it inevitably became embroiled in the internal security situation in Cyprus and the various crises in the Middle East from the Lebanon and Jordan, to Iraq and Aden. There was a continued rise until 1975 in the number of personnel at the base to meet the ever changing commitments, and the range of aircraft broadened to represent most of the front line operational elements of the RAF. The first Lightning F3s of No 56 Sqn arrived in April 1967 to provide all-weather air defence. Through the 1960s the Canberra squadrons of the Near East Air Force Strike Wing provided the air strike power for CENTO, until they were replaced by two squadrons of Vulcan B2s (Nos 9 and 35 Squadrons) in January 1969. The search and rescue capability was expanded with the establishment of No 84 Sqn with Whirlwind HAR10s in 1972. Hastings transports arrived with No 70 Sqn and were subsequently replaced by Hercules.

A major change occurred in 1975 when the Defence Review prescribed that all of Akrotiri's fixed-wing flying squadrons were to re-deploy to the UK leaving No 84 Sqn with its SAR and UN commitments, together with No 34 Sqn RAF Regiment. So for three years the base was little more than a shadow of its former self – that was until the advent of the Armament Practice Camps for UK and Germany based air defence squadrons. Each of the squadrons, starting with No 56 Sqn in August 1978, was detached to Akrotiri for up to five weeks every year to carry out intensive gunnery training. The pilots of the Lightnings, and as they were replaced in turn by Phantoms and Tornado F3s, have continued to make use of this facility over the past 20 years. Other units, particularly the operational conversion units, have taken advantage of Akrotiri's excellent weather to carry out their training. The RAF display teams, the *Red Arrows* and the *Falcons* parachute team are both regularly detached to the island for training, prior to the start of the new season.

While sitting on the beach at Limassol soaking up the Mediterranean sun you might see the coming and going of the No 10 Sqn VC10 C1K on its twice-weekly scheduled service from Brize Norton, tankers from the same base with their trail of Jaguars or Tornados passing through, a Tornado F3 or two on APC, and if its the right time of year, the *Red Arrows* rehearsing their smoky routine. But wherever you are around the coast of southern Cyprus you will almost certainly see a grey-painted Wessex HC2 of No 84 Sqn, Akrotiri's only resident RAF operational squadron.

REMEMBERING THE PAST – AKROTIRI'S GATE GUARDIANS

RAF Akrotiri's two gate guardians, a **Whirlwind HAR10** of No 84 Sqn and a **Lightning F6** of No 56 Sqn, both served at the base before retirement. Whirlwind XD184 was the first of its type to arrive in Cyprus on 17 August 1969. It carried out hot-weather trials before joining 1563 Flt at Nicosia. It transferred to No 84 Sqn in January 1972 when the squadron formed at Akrotiri and was the last to fly operationally with it on 1 March 1982.

Lightning XS929 was operated by No 56 Sqn at RAF Akrotiri from August 1973 to January 1975, when it was an F3 with a smaller ventral fuel tank. Later converted to F6 standard it was based at RAF Binbrook, from where it was flown back to Cyprus on 19 May 1988 to be preserved as a gate guardian. It was repainted in No 56 Sqn's markings, as worn by the Lightnings flown in the early 1970s from Akrotiri.

A pair of Jaguars from Coltishall lift off from Akrotiri where they had night-stopped before continuing on to the Gulf. Peter R March

No 84 Squadron, whose squadron badge is appropriately a scorpion and motto *scorpiones pungunt* (scorpion's sting), has served in the Middle East throughout most of its 81 years history and has not been based in the UK since January 1920. It has been an active part of the flying scene in Cyprus since mid-January 1972 when it was re-formed from No 1563 Flt and a detachment of No 230 Sqn, with Whirlwind HAR10s. Its task then, as now, was to provide search and rescue cover for air operations out of Akrotiri and general SAR within the Nicosia Flight Information Region, together with helicopter support activities for the British Forces and the UN, and assistance to the civil community. Until 15 October 1986 the Squadron was an integrated part of the British assignment to UNFICYP, but today its links with the UN are specifically medical and casualty evacuation. The Whirlwind was replaced by the twin-engined Wessex HC2 early in 1982, giving a much better range for SAR and lift-capability.

These yellow-painted Wessex were in turn replaced by five former Fleet Air Arm Wessex HU5s by June 1984. Able to carry external fuel tanks to increase their over-water range and painted in grey/green camouflage with a light-blue rear fuselage UN band, these Wessex were designated HC5C for their unique service with 84 Sqn. A further change of colour and version of the Wessex helicopter came ten years later, when the five HC2s, released from SAR duties in the UK, were shipped out to Cyprus. Painted overall in dark grey, in line with other Strike Command aircraft, but retaining the distinctive UN light-blue fuselage band, the veteran Wessex HC2s (one of them, XR588, first entered RAF service in October 1962) replaced the HC5Cs from January 1995. The Wessex have continued the tradition of identifying each individual helicopter with a playing card design on its tail – XR504 (joker), XR588 (ace of hearts), XS675 (ace of spades), XT680 (ace of diamonds) and XV730 (ace of clubs).

To meet its 365-day SAR standby and other commitments the Squadron needs to have three of the five Wessex available, with two 'in-use' reserves. In practice the two reserves are usually on overhaul or in deep maintenance, receiving modifications to the airframe, engine or systems. It is expected that they will remain in service until 2002, when it is hoped they will be replaced by ex-RN Sea Kings fitted with new 'glass' cockpits similar to the RAF's new Mk 3As.

Apart from SAR, casevac and medevac, one of No 84 Squadron's unique 'services' to the community, is assisting at the scene of major fires, using their underslung Simms rainmaker buckets. Assistance was rendered in fighting a huge fire near Kyrenia in Northern Cyprus. It raged for three days and ravaged a large part of the mountainside. Wessex air and ground crews worked virtually non-stop throughout the period and played an invaluable part in bringing the fire under control.

Returning to the station commander, Gp Capt Williams, for the final questions about RAF Akrotiri's future, he was confident that it had an ongoing vital role. "With its key strategic position as sovereign territory in an area of great uncertainty, the importance of RAF Akrotiri can only increase in the coming years". And is a posting to the 'island in the sun' a matter of sea, sand, Keo beer and stifados, with the interruption of work? "They are some of the advantages of working here, but as you will appreciate you have to work hard as a member of a large team all pulling together, to be able to enjoy these benefits. Akrotiri is in good shape."

Edwin Shackleton
makes a nostalgic flight in the RAF's famous wartime heavy bomber, the Avro Lancaster.

Thirty Displaying Years

Top: The Battle of Britain Memorial Flight's Lancaster PA474. BBMF

Inset: The cockpit layout of PA474, showing the dual controls that were fitted prior to the start of its display flying. Brian Strickland

It seems remarkable that the RAF Battle of Britain Memorial Flight's Lancaster PA474 has represented this highly successful World War 2 bomber on the air display scene for over 30 years. There are many requests for the veteran to fly past or display throughout the UK and these are initially vetted by Strike Command Participation Committee. Then the OC BBMF can arrange (and select) a programme to fit in with the permissable hours and the co-display with the Spitfires and Hurricane. Every effort is made to cover the major events (the longer nightstop events require support from the Dakota for ground crew and equipment) and in particular, to fit in other venues in transit. There are requests for anniversary fly-pasts in remembrance of WW2 dates, media documentary stories, or the popular village fêtes around the country.

Combined memorial for Nos 12 & 626 Squadrons at Wickenby. E A Shackleton

CAA and RAF regulations do not now allow passengers to be carried during a flying display, even on an airliner. However, this does not apply to fly-pasts and I was privileged to be aboard PA474 for such a flight in September 1997. Fortunately the weather was clear and after a briefing by our captain, Squadron Leader Dave Buchanan, and equipped with our flying kit, we were boarding PA474. I manoeuvred myself into the mid-upper turret under the guidance of ground crew guardian Jun Tech Rick Amy. Through the intercom, we listened to the check list procedure and start up – a team effort with the captain, co-pilot Squadron Leader Dave Thomas (ex-Vulcan display pilot) and engineer M Eng Nick Jones. From the mid-upper turret, the view is, of necessity, outstanding and on take off rotation included forward vision. The bank angle seemed accentuated looking down on the camouflaged wing as the captain took PA474 on a low level run for the assembled gathering of the Lincolnshire Lancaster Association at RAF Coningsby.

Setting course just below 1,000ft over the flat Lincolnshire 'bomber country', navigator Flt Lt Paul Wilkins gave a heading then pinpointed the first venue – Lincoln showground. This is immediately south of RAF Scampton where No 617 Squadron was formed and the base from which, on 16 May 1943, the Lancaster force took off for the 'Dam Busters' raid. It was also the base of Lancaster Mk1 R5868 which completed a record 144 operations with Nos 83 and 467 Squadrons and is now preserved at the RAF Museum, Hendon.

Off to the east, the second venue was Wickenby where the runways were soon spotted – in fact the northern cross runways are still used by Wickenby Flying Club. Where the wartime-closed country road crossed the eastern perimeter track, a group of ex Nos 12 and 626 Squadron (No 1 Group) members were grouped by the RAF Memorial. It was difficult to believe that this quiet airfield was once home to about four dozen Lancasters, supporting vehicles, equipment and personnel.

The memorial stands as a tribute to the extensive and sad loss of 1,080 men from the two resident squadrons while records show 160 aircraft were lost in over 6,000 sorties. One of the resident Lancasters flew 108 missions when aircraft life expectancy averaged only 40 hours and aircrew had a one in three chance of completing their tour of 30 operations. The final bombing raid that included Wickenby Lancasters was on Berchtesgaden on 25 April 1945. A complete change of role came with the repatriation by air of our ex-POWs from Italy, then a food drop to starving Dutch people in North Holland. The latter flight was distinctly shorter than the seven

hour round trips to Berlin known to most of the aircrew.

Lancaster PA474 continued our peacetime fly past just a few miles onward to Ludford Magna, original parent base to Wickenby and home to the Lancasters of No 101 Squadron. An even more deserted airfield, where the runway concrete was lifted and used in the Humber Bridge construction, it is now devoted only to farming. The RAF memorial lies neatly by the side of 'Magna Mile' in the adjacent village of Ludford and PA474 made three respectful passes over the site.

Ludford Magna's Lancasters included specially tasked aircraft for radio counter-measures. An extra crew member, who was German speaking, issued false information to enemy night fighters as well as jamming enemy radio. This made them more vulnerable as they could be pin-pointed from their signals. In fact 113 aircraft were lost in almost 5,000 sorties. Ludford Magna was one of 15 bases equipped with FIDO where petrol could be burned from pipes laid on the main runway edges in extreme foggy conditions. Bomber Command sorties regularly involved late returns to base when fog became thickest, so

Above: View from the port side of two of the Lancaster's four Merlin engines. E A Shackleton

many stations became fog bound. Some 2,486 successful landings were made on the FIDO runways despite problems of turbulence and the close proximity of burning fuel.

On D-Day, the specially equipped Lancasters (21 aircraft) were used to jam enemy radio transmissions over Northern France. Only 35 Lancasters logged more than 100 sorties and No 101 Squadron has the proud record of three Lancasters having achieved this number. Today Ludford Magna lies peacefully with just a few scars of war. The Cold War Thor missile bases (from 1959-63) are the only remaining significant evidence.

PA474 is the last airworthy Lancaster in the UK. Produced by Vickers Armstrong at Chester, it was delivered in September 1945 and served initially with No 82 Squadron, having been modified as a PR1 photo reconnaissance machine. After a useful spell of mapping in Africa, it passed to Flight Refuelling at Tarrant Rushton. A distinct change of role a followed after allocation to the College of Aeronautics at Cranfield where it was used as a testbed with aerofoil sections mounted vertically over the rear fuselage. It remained in RAF markings, with the code letter 'M' from its African survey duties, but lacked all gun turrets. A nine-year spell at Cranfield ended in 1963.

Meanwhile, the last Lancasters in RAF squadron service were operating from Luqa, Malta, but these MR3s of No 8 Squadron were in the process of being replaced by the Avro Shackleton. The Lancasters were ferried back to the UK for scrapping and the farewell ceremony was held at RAF St Mawgan on 15 October 1956, when the last squadron aircraft (RF325) made a low flypast over the cornish airfield before its final flight to Wroughton.

Following its research duties at Cranfield, PA474 was taken on charge by the Royal Air Force Air Historical Branch and, in 1964, it was flown to the Maintenance Unit at Wroughton and painted in a wartime camouflage scheme before being flown to RAF Henlow for storage. The OC No 44 Squadron at Waddington, realising the historical value of PA474, managed to 'acquire' the Lancaster for restoration. It was no coincidence that No 44 (Rhodesia) Squadron flew the very first operational sortie with the type. (This took four Lancasters on a minelaying flight on 3 March 1942 to the Heligoland Bight followed one week later by an incendiary attack on Essen).

PA474 was granted regular flying permission in 1967 and began operating from RAF Waddington. It has since been seen regularly at UK air displays, and in 1973 the Lancaster was linked with the Spitfire and Hurricane fighters when it joined the Battle of Britain Memorial Flight (BBMF). Since 1976, the BBMF has been based at RAF Coningsby, where PA474 acquired its final 'trim' with the installation of the mid-upper turret on 18 March 1976.

Despite its new lease of life, the Lancaster remains limited to a maximum of 100 flying hours a year and is kept within a reasonably restricted flight envelope.

Another essential addition to the Lancaster was a fatigue meter. The Lancaster wing design was subsequently used in the Lincoln, Shackleton and Argosy. Cracks in the top spar booms of the latter aircraft led to structural fatigue tests on the Shackleton wing (the AEW Shackleton, it will be recalled, was experiencing a necessary life extension due to the Nimrod AEW fiasco). From test data, it was assessed that the safe fatigue life of the Lancaster was 4,400 flying hours and that this would be accomplished by the end of the 1995 flying display season.

A well synchronised work programme subsequently commenced on 25 September

Sqn Ldr Dave Buchanan at the controls of PA474 en route to Wickenby. Note the close proximity of the co-pilot: wartime Lancasters were single-pilot operated. E A Shackleton

1995, when PA474 was flown to St Athan, where an RAF team had been assembled to start the dismantling process – engines, undercarriage, wing removal and fuselage 'split'. The wing/fuselage centre section was road-transported to British Aerospace Aerostructures at Chadderton, Manchester in late October where new spar booms had already been machined from extrusions still available from the Shackleton re-spar programme. The extensive work programme on the centre section, including shift work, was completed in four months, with the outer wings following later. Re-assembly at St Athan included not only the structure but also the hydraulics and electrics and full systems checks – the first time that any Lancaster had been subjected to such an extensive work programme. After a successful test flight on 13 May 1996, PA474 was flown back to its base at RAF Coningsby two days later, welcomed home by the BBMF, the press and enthusiasts.

Despite its new lease of life, the Lancaster remains limited to a maximum of 100 flying hours a year and is kept within a reasonably restricted flight envelope – a very sensible action that allows an adequate demonstration of the aircraft's flight characteristics to an admiring public. Long may it continue.

PA474 passes low over Ludford village and its memorial to No 101 Squadron aircrew. E A Shackleton

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Participating air and ground crews from around the world at last year's Royal International Air Tattoo were invited to attend the Fighter '97 symposium, where future fighter aircraft, tactics and training were on the agenda. **Chris Pocock** reports.

Into the future – the Joint Strike Fighter (JSF).

FUTURE FIGHTERS

Each year, The Royal International Air Tattoo organises a one-day symposium with an operational theme to coincide with 'The Show' at Fairford. Air and ground crews who have flown in for the Tattoo are transported to a conference venue in London, where they join other distinguished invitees to listen to keynote speakers and participate in discussion sessions on the Tattoo theme.

Last year, the theme was 'fighters'. Over 250 people gathered at The Queen Elizabeth II Conference Centre in Westminster to hear about new aircraft, new tactics, and new training methods – indeed, the new realities of being in the fighter business in the post-Cold War era. All ten speakers were former or present-day fighter pilots, with experience on a huge variety of aircraft, from the Javelin and MiG-15 through the Lightning and Phantom to today's Tornado, F-15 and MiG-29.

The Fighter '97 symposium was sponsored by Lockheed Martin, but that did not prevent the merits of other manufacturer's products being discussed! In fact, a presentation on Eurofighter 2000 by Wg Cdr Peter Legg from the MoD's Operational Requirements Branch was one of the day's highlights. Starting with a forthright condemnation of 'ill-informed comment and highly simplistic analysis' in press articles, Wg Cdr Legg explained that the starting point for the Eurofighter design was the old-but-true assumption that, 'if you lose the air battle, you lose the war'. The new aircraft was optimised for air superiority, but with sufficient multi-role capability to replace the Jaguar in the air-surface role.

"All of our work and historic experience has shown that a whole system approach is necessary to deliver the required capability," he continued. Eurofighter was a matched suite of platform, weapons and avionics. Its Attack and Identification System would not only receive inputs from the ECR-90 radar, but also from the Infra-Red Search and Track (IRST) system, electronic surveillance systems and (via data-link) the Multi-Function Information Distribution System (MIDS).

Mindful of his audience, which contained a high proportion of fighter pilots, Wg Cdr Legg explained the Eurofighter cockpit in some detail. Development engineers and ergonomics specialists had been advised by a working party of eight test and operational pilots – two from each of the four nations which are collaborating on the new jet. These pilots had heavily influenced the design, making over 1,000 recommendations on such aspects as display symbology, data presentation architecture, and HOTAS (Hands on Throttle and Stick) controls.

"The main object has been to present the pilot with just the right information at the right time", continued Wg Cdr Legg. "In combat, he would not need to take his hands off the throttle and stick, thanks to the sophisticated HOTAS controls. New Direct Voice Input (DVI) technology would allow the pilot to change radio frequencies, obtain the aircraft's fuel state, or perform a variety of other tactical and domestic tasks. DVI is perhaps the single most important advance in aircraft systems management," said Wg Cdr Legg.

"Eurofighter is a stunning aircraft to fly... highly capable and safe...with the potential to be the most flexible and effective air weapons system the UK has ever owned," he concluded.

"Clever integration is also the key to future STOVL (Short Take-Off, Vertical Landing) fighter operations", Flt Lt Justin Paines told the symposium. He is project test pilot for the VAAC (Vectored-thrust Advanced Aircraft flight Control) Harrier programme, and the integration he described was of the flight and propulsion controls in this experimental testbed aircraft. "The goal is to eliminate in the next generation of STOVL (Short Take-Off and Vertical Landing) aircraft, the considerably greater workload involved in flying today's Harrier, compared with conventional fighters," he said. The VAAC Harrier is a converted two-seat T4 airframe, which allows the rear-seat occupant to try out new flight control software, while a safety pilot stands by to take over if something goes wrong.

A description of the two new generation fighters being developed in the USA was provided by Brig Gen Bruce Carlson, and Lt Gen George Muellner, USAF. The F-22 Raptor would be the top-of-the-line 'air dominance fighter', whereas the Joint Strike Fighter (JSF) would be a less expensive but very capable 'precision air-ground truck', said Brig Gen Carlson. He declared that the USAF's current F-15/F-16 fighter force could not be modified to meet the growing threat of airspace denial, especially from enhanced surface-to-air missile (SAM) systems such as the SA-10.

"The F-22 has all-aspect stealth, which dramatically reduces the SAM engagement envelope," he continued. But Lt Gen Muellner also told the symposium that low-observability was not the total solution, because of

The packed conference hall at the Fighter '97 symposium, held in London in July last year.

BAe

Fighters for the new millennium: Eurofighter (top) and the F-22 Raptor (above).

affordability, and air arms also needed to employ electronic warfare and stand-off attack assets. The attack capability of combat aircraft would be enhanced by new 'smart' bombs which provide the same destructive capability with a 220lb weapon as was previously provided by a 1,000 or even 2,000lb weapon.

Looking further into the future, "we will begin to migrate fighter missions to Uninhabited Air Combat Vehicles (UACVs), and develop prototypes for the SEAD mission (Suppression of Enemy Defences) by 2000", said Lt Gen Muellner. "But I do not see UACVs assuming any operational capabilities pre-2020," he quickly added, as the fighter pilots in the audience began looking nervous!

Air Chief Marshal Sir William Wratten, then Commander-in-Chief of RAF Strike Command, doubted whether UACVs would ever replace manned aircraft, but he did look forward to new technology which would turn night into day, and eliminate weather as a factor' in air combat operations. He recalled the speed with which the RAF's Jaguars had been modified with the TIALD laser-designator pod, and the towed radar decoy adapted to the Tornado F3, for recent operations. But there was a limit to how much equipment could be 'strapped on' to existing aircraft, he said. Cheap platforms plus intelligent weapons were not the answer: his advice was to 'buy the best you can'.

Other speakers highlighted some present-day tactics and concerns. Opening the symposium, Chief of the Air Staff Air Chief Marshal Sir Richard Johns noted that the Rules of Engagement (ROE) for air operations are subject to tight political control, and were likely to remain so in the type of low-intensity conflicts which the RAF now faces. It would be 'a challenge to devise robust ROEs' for beyond-visual-range air combat of the kind made possible by advances in missile and aircraft design. Sir Richard also mentioned the 'intelligence and discrimination problem' which now arises as NATO is enlarged to include Central European countries operating former Eastern Bloc equipment.

The RAF chief declared himself a strong supporter of joint force operations and the capability to deploy flexibly and rapidly to political trouble spots in the national interest. But these required the services to maintain a high degree of readiness, and conduct operations at a surprisingly high tempo –Tornado F3s had clocked up 11,000 flying hours over Bosnia during Operation *Deny Flight*, for instance. He wondered whether the public was prepared to pay for all this in the absence of an obvious, general threat to the UK's security.

The 'radically-changed security environment'

"Eurofighter is a stunning aircraft to fly...highly capable and safe... with the potential to be the most flexible and effective air weapons system the UK has ever owned".

was also mentioned by Maj Gen Attila Kositzky, Chief of the Hungarian Air Force. But although this had recently caused 'a major structural reform' of his service, the air and air defence units had acquired greater strategic status in Hungary, he said.

The symposium gained an Asian perspective from Capt Hiroshi 'Bechi' Hama, one of two Japanese Air Self Defence Force officers making that service's first-ever visit to an International Air Tattoo. He described the air defence situation around Far East Asia, using his experience as a current F-4 instructor pilot with the 8th TFS, and as a former test pilot for the upgraded F-4 Kai project.

The architect of the air war during *Desert Storm*, Charles (Chuck) Horner, related some of the 'lessons learned' from the conflict with Iraq. The USAF General said that modern battlefield surveillance assets, like JSTARS, increase the temptation to over-centralise the direction of combat operations. His job had been to define the overall aims, but not to hamper the freedom of action of commanders in the field. The daily Air Tasking Order (ATO) which emerged from the 'Black Hole' at Riyadh (the allied command centre) did have the benefit of continuous input from field commanders, he pointed out. Furthermore, the officers who had worked on a particular ATO would fly on AWACS during its execution, and they were empowered to change the details as the battle developed.

Gen Horner was critical of intelligence support during the conflict: "We knew nothing about our Iraqi opposite numbers in command, for instance". We tend to look at the enemy through our own eyes, he noted. He had selected the Baathist Party HQ in Baghdad as a priority target, but 'now realised that was a mistake'. The Iraqi population at large did not care about the Party, and he would have been better advised to target the secret police HQ of every major Iraqi town!

Later, Gen Horner was joined on the platform by ACM Wratten, who had served alongside him during the conflict as commander of the deployed RAF forces. The pair led a discussion session, during which Gen Horner emphasised the value of training in general, and joint exercises in particular. He recalled that, "When Bill Wratten walked into the Black Hole, he was straightaway at home, as we had previously worked together at Red Flag".

Other speakers also agreed that training remains the key to success, and Gp Capt Nick Spiller from Air Operations at RAF Strike Command devoted his presentation to the subject. Despite the shift to limited conflicts and peacekeeping roles, he insisted that fighter pilots should still be trained for all-out combat. "Even limited wars can be lethal, and some of the governments with which we might wish to quarrel have formidable assets...agile fighters and latest-generation SAMs, for instance".

Gp Capt Spiller said that modern air forces should place more emphasis on teaching situational awareness to their fighter pilots. A former Hunter, Lightning and Phantom pilot with over 4,500 hours, he neatly summed up two major themes emerging from the Fighter Symposium: "In the old days of fighter sweeps by wings of aircraft, you could get away with having *Top Guns* only at the head of each four-ship, with some fairly second-rate wing men hanging on down the back. Today we have fewer aircraft, but each fighter has the reach, vision and weapons capability of a whole wing of those earlier aircraft. If the pilot in control is not a *Top Gun*, he should not be there at all. There will be no room in the fighter cockpit of the future for the mediocre!"

Overall, the Fighter Symposium was seen to be a most successful and professional day and the timing was apposite with the new inventory of fighter aircraft currently under consideration.

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A-1-98-179-A2

PER JETSTREAM AD ASTRA

Paul Jackson looks at the Jetstream's long contribution to RAF multi-engine pilot training.

Which RAF training unit produced the greatest number of qualified pilots in 1997? Surely, No 4 Flying Training School (FTS) at Valley, with its three Hawk squadrons; if not, it must be No 60 (Reserve) Squadron, part of the Defence Helicopter Flying School at Shawbury, and newly equipped with a fleet of glossy yellow and black Squirrels. Wrong both times. Twenty-five years after they first entered RAF service, the 11 Jetstream T1s of No 45(R) Squadron at Cranwell are producing some 59 fresh pilots per year, just slightly ahead of the new 'wings' awards at Valley.

Given the low profile of the Jetstream, it is not surprising that its achievements are little known. Unlike its stable-mate, the Dominie, it has not undergone a major upgrade , nor will there be a black Jetstream, for two more years, to excite aviation photographers. As the sole provider of RAF multi-engine pilots and the only aircraft type at Cranwell actually to award 'wings' to its graduates, the Jetstream deserves wider recognition.

Designed and initially put into production by Handley Page (and at one time on order for the USAF, designated C-10), the Jetstream was selected by the RAF as a twin-conversion trainer to replace the Vickers Varsity. After the originating company's bankruptcy and a short-lived successor, the aircraft was put back into production by Scottish Aviation (later part of BAe) at Prestwick. It was from here that the first of 26 was delivered to Boscombe Down for trials on 21 July 1973 and, on 12 September, to the Central Flying School at RAF Little Rissington.

No 5 FTS at Oakington, near Cambridge, began equipping on 10 June 1974, but only 12 had been taken on RAF charge when a defence review concluded that there were enough multi-engine pilots at that time. The six then at Oakington were flown to St Athan for storage on 31 December 1974 and the production line marked time. At length, future RAF requirements were assessed as 11 aircraft, and the rest (less one lost in an accident) were transferred to the Fleet Air Arm for observer training. All but one of the current RAF fleet were from re-started production.

On 25 November 1976, XX497 was delivered as the first aircraft for No 3 FTS at Leeming, where the Multi-Engine Training Squadron (METS) was formed on 4 May 1977 to operate them. METS moved to become part of No 6 FTS at Finningley on 30 April 1979 and adopted the new title of No 45

Below: The Jetstream's flight deck has changed little in 25 years, but GPS satellite navigation is shortly to be installed. All photographs Paul Jackson

(Reserve) Squadron on 1 July 1992, complete with the traditional markings of a winged camel badge, plus red diamonds on the fintip. On 1 October 1995, it officially took up residence at Cranwell, where its current CO is Sqn Ldr Garry Griffin.

No 45's creditable student output is achieved by just 15 instructors, of whom five are civilians. Both 'A' and 'B' Flights have five staff each for flying duties, the latter flight also contributing to operating the dynamic simulator. Standards Flight has two instructors, plus the squadron CO. The civilian Aviation Officers (AvO) are civil servants with the equivalent rank of Flight Lieutenant who play a full role in the squadron but who are engaged on civilian terms (no compulsory postings, one month's notice of resignation, etc). All are currently ex-RAF, although any suitably qualified person can be appointed as an AvO at this and other RAF training units.

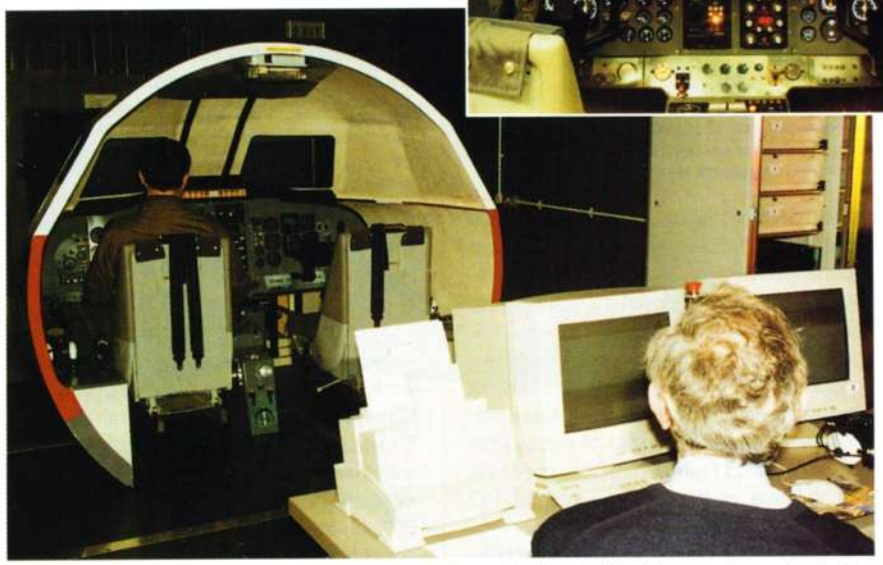
It is as well that not too many AvOs are footloose, for No 45(R) Squadron has no 'slack' to allow for personnel shortfall. Even the inevitable illness, or a period of bad weather leaves the unit working harder than ever afterwards to keep courses on time. Seven different types of course are provided and the squadron also has to supply the occasional Jetstream for light transport and communications for HQ Personnel & Training Command, the latter requiring some 100-150 hours of flying per year.

Every eight weeks, five or six students report for the Long Advanced Flying Training course – AFT (Long). These are personnel who have either gained 90 hours of flying on Bulldogs at a University Air Squadron or joined the RAF directly and flown civilian Slingsby Fireflies at the Joint Elementary FTS. Both groups take a further 30 hours of multi-engine lead-in (MELIN) training on either of these types before stepping into a Jetstream.

Their stay with No 45 is 26 weeks and includes 224 hours of classroom studies as well as 50 hours in simulators and 70.5 hours in one of the Jetstream's front seats. (Not included in the sums are 12 more hours on a flight deck jump seat gaining experience by looking over the shoulders of other students.) Simulators range from a wooden cockpit with painted instruments, through adapted PCs to the highly realistic instrument trainer (for simulating radar-directed approaches) and the 'dynamic' simulator. The latter, a completely realistic cockpit in which 30 hours are spent, provides full emergencies training. Because of safety considerations, its hydraulic rams have been inactivated and it is 'dynamic' in name only, since its move from Finningley.

Airborne hours are divided between general handling, night flying and instrument/ navigation flying. Only 9.5 of the 70.5 are flown solo, for the aim is to provide students with a transition course between single-engine trainers and larger, two- or four-engined aircraft, rather then teach them to fly a Jetstream for a career. On leaving Cranwell with their newly awarded wings, graduates progress to an Operational Conversion Unit, to fly the Hercules, VC10, Nimrod, Tristar or Sentry and possibly progress later to the BAe 125 or BAe 146.

This necessarily simplified account of the main training stream might suggest that money could be saved by sending students to a civilian school specialising in airline training. This has been done on a trial basis and the subsequent progress of the graduates is being monitored. Attractive though it may appear to the accountants, there are hidden costs and drawbacks.



The instrument simulator allows students to practice radar-directed landings, and is controlled by one instructor at a PC. A hard copy of the flight route is produced for later analysis by the student.

Outside formal instructional hours, flying school students 'hang about in a cafeteria' (as one officer unkindly put it) instead of continuing general service training and developing their leadership abilities and other skills of a military nature. Their flying takes place in a benign environment, usually at an airfield accustomed to novices in the circuit. Contrast that with No 45 Squadron's *modus operandi*: flying in and out of a very busy service airfield and concentrated military flying area, regular visits to regional airports such as Humberside, Liverpool and Leeds/Bradford, other RAF stations and locations overseas.

Indeed, those students destined to join No 216 Squadron remain at Cranwell for a further 15 hours of flying Jetstreams on the Tristar Enhancement Course which accustoms them to operating at large European airports or in airways under the direction of busy foreign controllers. In short, flying schools turn out First Officers; No 45 Squadron produces military pilots who will be capable of commanding an aircraft within a couple of years of joining their first squadron.

A similar result is achieved by the AFT (Short) course of 45 hours in 18 weeks for students transferred from the fast-jet training

The Jetstream first entered service with the RAF as a flying classroom in 1973 and is set to continue well into the next century as the service's sole provider of multi-engine pilot training.

The civilian staff of Hunting Contract Services keep the Jetstream fleet flying. A 35-day Equal servicing is required every 600 flying hours.

stream, or the 31 hour/10 week multi-engine cross-over (MEXO) course for more experienced pilots moving up into the multi-engine world. Others, perhaps returning to transport flying after a desk job, will take a 15-hour refresher course on Jetstreams before a transport OCU. Finally, of course, and despite what has been said above, some pilots do fly Jetstreams for a living, so No 45 has to train its own Qualified Flying Instructors under the watchful eye of the now co-located HQ Central Flying School.

To achieve this output on a total of at least 30 courses per year, the squadron generates over 5,500 flying hours annually, plus 2,500 more in the simulator. Keeping the aircraft flying, with at least seven Jetstreams out on the line each morning, is the civilian firm Hunting Contract Services. Also responsible for Dominies and Bulldogs, HCS is civilian in title only, for 98 per cent of its personnel under Chief Engineer John Wilcock are experienced ex-RAF, and it is organised in the manner of a typical RAF engineering wing, with a first line hangar for corrective and flight maintenance and a scheduled maintenance hangar.

In general, the Jetstream is a simple aircraft to maintain and suffers no structural or corrosion defects, in spite of its advancing years. Such technical faults as it does possess are more of a 'fiddly' nature: microswitches and heat-exchangers, for example, as well as the need to analyse the 996 shp Astazou XVI's oil for signs of engine wear every ten flying hours. Nothing on the aircraft is impossible, as illustrated by the hard and eventually successful work which HFC put into rectifying chronic fuel tank leaks a couple of years ago.

Apart from its engines, which go back to Turboméca in France, all Jetstream support work is undertaken at Cranwell, with BAe supplying the spares. The aircraft is on an Equalised Servicing cycle, which does away with Minors and Majors: it receives a Primary after 200 hours, another after 400, whilst at 600 hours the 'Equal' (taking 35 days) consists of another Primary plus a quarter of the work which would have been done at a Major. The other three quarters are spread over the next 1,800 hours.

With an average flying time of 8,000 hours (and 25,000 landings) per airframe, the Jetstream fleet has been through several such cycles. At the beginning of this year, the leader was XX498 with 8,980 hours, whilst the least used was, perversely, the oldest aircraft, XX482 with 7,275 hours. It is also worth reporting that since the reference books were written, the Jetstream has put on a little weight in middle age, so that empty (with just four passenger seats installed) it is now 4,025 kg (8,875 lb), whilst the maximum permitted take-off weight has been increased to 6,000 kg (13,225 lb).

Avionics are much the same as when the aircraft was delivered, but a modest update is in prospect with a satellite navigation system: a Garmin 100 GPS has been installed in XX492 and the fleet soon will be equipped with that or a later model. This is one example of how No 45 tries to respond to the requirements of its 'users' (the OCUs) by preparing students for what they will be expected to know when they take the next step in their flying careers. Formation flying and low-level work are also included in the course, because tactical transport demands both skills.

After a quarter of a century of Jetstreams, the number of captains who made their acqaintance with multi-engines on anything else is small indeed. Structurally, the Jetstream is good for at least another decade, providing the RAF's transport, tanker, AEW and maritime reconnaissance pilots. So, if Europe gets its act together quickly, some of the first co-pilots for the Airbus FLA could just be trained on the last of the RAF's Handley Pages.

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BERLIN airlift

THE BRITISH CONTRIBUTION

Above: Unloading coal from Hastings TG553 at Schleswigland. RAF Museum

Few sieges have been overcome as efficiently as the 1948-1949 blockade of West Berlin, in which the skilful application of the then biggest ever air supply operation nullified the efforts of a determined adversary. On the 50th anniversary of the Berlin Airlift, **Michael J F Bowyer** looks back at the British contribution to this massive operation.

At the end of WW2 the US government thought Communist subversion would best be prevented by Western Europe rebuilding itself along democratic lines. George Marshall, US Secretary of State, strengthened the idea with a massive aid programme, The Marshall Plan, announced in June 1947. Concluding that governments unsympathetic to Soviet ideas would be established, the USSR quickly extended its influence over Eastern Europe. In February 1948, a coup d'etat toppled the Czechoslovak government, but the main Soviet aim was to prevent establishment of a democratically elected West German government.

Berlin in 1948 remained jointly administered by the USSR, Britain, France and the USA. Some 110 miles inside the Russian Zone of Germany, it was reached by mutually agreed road, rail, air and river routes passing through the Russian controlled area. Relations between the Allies and the USSR steadily deteriorated from 1945, and in April 1948 the USSR began interfering with Allied movement to Berlin. Sensing that the USSR might block land routes, thereby entirely isolating Allied garrisons and German civilians, Britain's Chiefs of Staff, in considering flying supplies to them, reckoned some 4,000 to 5,000 tons would have to be delivered daily. Of this total about 2,000 tons would be for the 2,100,000 civilian population. Much RAF Transport Command funding had recently been switched to other Commands, leaving its UK strength at just eight squadrons of Dakotas, eight of Yorks and two conversion units holding in total fewer than 200 aircraft. They would be only able to convey about 400 short tons* daily, thus making US involvement essential.

HQ British Air Forces of Occupation (BAFO) produced a suitable plan, Operation *Knicker,* to put in place an airbridge linking the British occupied area of Germany with Berlin's British garrison. The USAF prepared a similar operation, code-named *Vittles*. Planning for *Knicker* was completed on 17 June 1948.

When the USSR closed all surface routes to Berlin on 24 June 1948, the executive order was signalled to HQ 46 Group controlling the RAF's Dakotas. The only way to supply Berlin – short of a land engagement – would be for unescorted Dakotas to proceed along one of the two 20-mile wide corridors leading from Hanover and Hamburg then parachute in, or land, supplies at Gatow in the British Sector, or at Tempelhof which the US controlled. Russian belief was that the West would not, and probably could not, continue any air supply to the city for long.

The following day the Russians announced their refusal to supply food to anyone in the Western Sectors of Berlin, and 13 Dakotas of RAF Transport Command were ordered to Wunstorf, as the evolving crisis deepened. During that day, eight Dakotas made the move to Germany and three of them carried out a probing corridor reconnaissance. It was abundantly clear that the airlift was likely to become an ever expanding undertaking.

Before ordering RAF aircraft to start supplying British forces in Berlin, the likely response from the Russians needed careful consideration. If they fired upon the transports a major conflict could easily and rapidly ensue. While this was deemed unlikely, possible positioning of balloons within the corridors would make flying hazardous. The Allies would have to destroy these, a hostile act which would also bring about a very hazardous escalation. No such scenario developed, but when at 06.00 hr on 26 June the first Dakota left Wunstorf for Berlin, the situation was very tense. At about the same time, from Weisbaden, the USAF despatched the first of many Douglas C-54 Skymasters along the southern corridor to Tempelhof.

Over the following 24 hours the 13 RAF Dakotas safely delivered 44 tons of food for British troops without serious Russian interference. Next day, when the food lifts were repeated, it became clear that the forecast for a more extensive airlift was indeed necessary. The British at once revised its plan and unfortunately named it *Carter Patterson.* That provided the Russians with a propaganda coup and they quickly pointed out to Berliners the 'obvious' implications arising from the introduction of a famous British removal firm! The British quickly renamed its part of the operation *Plainfare*. Fortunately, Soviet ranting was not matched by offensive military response and the

Above: Berliners assist in the labour intensive task of unloading a York. RAF Museum

Right: Sunderlands were employed in the early stages of the airlift. This example, a Mk V, is seen unloading at Havel Lake. IWM

Russians mainly contented themselves by watching for any transport to stray from the corridor and 'buzzing' Allied aircraft – sometimes dangerously.

Avro Yorks, to back the Dakota contingent, began moving to Wunstorf on 1 July, the day the lift was started in earnest. Dakotas were loaded by the Royal Army Service Corps, taking 311 tons of food to German civilians and 94 tons for British troops. They could each carry a three-ton payload and fly up to three journeys per day, although each crew was limited to two runs. The Dakotas formed part of the short-range tactical transport support force, whereas the four-engined Yorks, although more expensive to operate and maintain, and better suited to long-range haul, were able to carry nine-ton loads. As the first examples were arriving at Wunstorf the USSR responded by withdrawing from the four nation Allied Kommandatura which had administered Berlin.

On 3 July, when Yorks first operated, 750 tons of freight were airlifted by the RAF which entailed employing much of Transport Command's serviceable strength. The USAF had by now activated the 7350th Air Base Group at Templehof to handle its C-47s and C-54s. Morale was high within the Services and to help maintain that of the Berliners a novel idea was brought into play. On 5 July, only two days after their use was mooted, Short Sunderland V flying-boats of Nos 201 and 230 Squadrons began working from the sort of primitive base seaplanes can use – in this instance a cluster of mooring buoys and small boats on the river Elbe, beside tented crew accommodation on the quayside at Finkenwerder. From there, the seaplanes flew to Havel Lake to unload near Berlin's Yacht Club. Use of the elegant Sunderlands showed the lengths to which the British were prepared to go to support their recent enemies.

Above: Passengers boarding a Dakota of No 53 Squadron about to leave Berlin. RAF Museum

So far, only the minimum amount of food needed to maintain health was being airlifted and it was obvious that much else would have to be conveyed including clothing and medical supplies, raw materials and heavy equipment along with large quantities of coal and liquid fuel. Sustaining employment and the economic progress being achieved by West Berlin's industries slowly recovering after destruction during the war, was deemed essential. To maintain morale, unemployment was never to be allowed to fall below five per cent. That implied delivery of enough energy sources to compensate for the loss of the five train-loads of coal that had travelled daily through the Russian Zone to West Berlin, prior to the blockade.

Maintaining energy supplies soon became a major problem that had to be dealt with. Gas supplies dependent upon coal were so organised that peak delivery came at meal times. Pumping sewage required electrical power. Although some dangerous seepage into rivers came about there never was any major health problems from effluent. Oil and petroleum obviously demanded special delivery in containers, and Ruhr Coal for industrial and domestic use would have to be airlifted in sacks. Although loading and unloading would be extremely labour intensive, there was no shortage of helpers. Once off-loaded, everything had to be highly organised and marshalled for onward transit. On 7 July, the first sacks of coal reached Berlin aboard an RAF Dakota, with the main lift starting on the 19th. Very soon coal dust in aircraft raised problems. During the current restoration of Avro York LV633 for the Imperial War Museum at Duxford, coal dust has been found in the aircraft a half century after its airlift service with No 24 (Commonwealth) Squadron.

When the blockade was imposed West Berlin lost two-thirds of its electricity supply and during the following winter endured many power cuts. Power stations in West Berlin were in a bad state but fortunately the Russians never stopped electricity flowing from their largest power station sited close to Gatow. Here was a bizarre situation, since the USSR supplied the airfield with most of its requirement. It was claimed at the time that Russians thought they were, financially, onto a good thing! They never cut all water supplies to the western areas, but as an insurance against that possibility, water was extracted from deep wells in the Allied sectors.

Gatow had, at the start of the airlift, only a 2,000 yd long PSP (pierced steel plank) runway and a shorter concrete one. An essential task was to fly in equipment and materials to complete the latter's extension. A sizable German labour force was assembled, fed, clothed and accommodated not only to finish the runway but also to lay a large asphalt apron upon wartime rubble brought from Berlin. The 2,000yd concrete runway came into use on 16 July, allowing flights to rapidly increase in number. On 20 July alone 2,250 tons of freight were airlifted to Berlin.

Over the first few days of the airlift the operation had been viewed as a stop-gap measure. After a month, much expansion was required. An important development came on 27 July, when the first British civilian aircraft was introduced on the airbridge, an Avro Lancastrian carrying supplies from Buckeburg to Berlin. Contracted through British European Airways (BEA) and the Ministry of Civil Aviation, Avro Tudors, Lancastrians and Halifax VIIIs – many with large internal fuel tanks installed – were soon conveying, from Wunstorf, all the liquid fuel supplied to Berlin. Upon delivery the fuel was fed into underground tanks, some being then transferred to Berlin by pipeline, or pumped to Havel for transfer by barge to the city.

The first full scale British civilian participation started on 4 August and involved flights from Fassberg, Wunstorf and by the civilian Short 'Hythe-Class' flying boats based at Finkenwerder. The multiplicity of aircraft types, let alone their numbers, increased operational difficulties. Whereas the USAF employed just one type of aircraft, the British were soon using four RAF and 11 civilian types, each making its own demands on air space, ground space and during turnaround.

By early August the RAF faced another problem. There were two USAF crews for each C-54 Skymaster in the airlift, while the RAF was short of personnel. Training of transport aircraft crews was suffering badly as a result of airlift commitments, so almost half of the RAF contingent had to be withdrawn to train further aircrew. This withdrawal, reducing Britain's daily lift by 400 tons, resulted in additional USAF C-54s being brought to Europe and based at Fassberg. To make space for them, the 24-strong RAF Dakota force that had left Wunstorf to civilian fuel tankers, now moved on to a new airfield at Lubeck, from where it resumed operations on 20 August. On 15 September, a further eight civil aircraft were drafted in to replace the

via Bruce Robertson

By 1 September 1949, an average of 130 RAF aircraft in daily use had delivered 23% of the freight flown to Berlin.

withdrawn RAF Dakotas and Yorks.

On 22 September, No 46 Group Advanced Operational HQ was established in a small castle at Buckeburg, a step towards the Combined Airlift Task Force, a joint RAF/US organisation agreed upon in principle on 30 September. Established on 28 October, it was commanded by Lt Gen John K Cannon, USAF, whose deputy was Air Commodore J W F Merer RAF. By this time a squadron of the Royal Australian Air Force had been joined at Lubeck by another from the South African Air Force and soon by yet another, from the Royal New Zealand Air Force. British aircraft were now delivering about 450 tons of freight daily, a sharp decline from the average of 1,100 tons airlifted in August.

Britain's contribution to the airlift was strengthened by the decision on 7 October to introduce the new Handley Page Hastings, that had entered RAF service in September 1948. Schleswigland, chosen to accommodate them, opened on 1 November and at once received examples from No 47 Squadron. In common with other British operational types, the Hastings had side door loading and tail wheel undercarriage, which did not make for easy freight handling. The Hastings, which commenced airlift operations on 11 November 1948, could carry a nine ton load and was used mainly to carry coal.

From October all the civilian aircraft, with the exception of tankers, operated from Hamburg/Fuhlsbuttel and gradually the Handley Page Halifax VIII became the main type used. Operations now took place 'round the clock' and movement intervals between aircraft were shorter. By winter all flying was more coordinated with types of aircraft operating together in batches. Time blocks of up to four hours were allocated to them. In fine weather one landing and one departure took place at Gatow over three minutes allowing just 90 seconds for each movement. In bad weather which embraced snow, rain and gales, two movements took place within five minutes. There was also fog to contend with, which meant periods of airfield closure, not to mention last minute diversions calling for skilled flying and steady nerves.

On 3 November the Allied air forces completed delivery of 300,000 tons of supplies, and by the 22nd that figure had risen to 500,000 tons. RAF Dakotas began flying on 18 November to Tegel, a new terminus just completed in the French Sector and to which mainly coal and liquid fuels were flown. Officially opened on 1 December, the first British civil flight arrived on 15 January 1949. BAFO's airfield at Celle had, in the meantime been improved to allow C-54s to start operating from there on 17 December. By mid-January 1949, 229 C-54s were taking part in the airlift.

Wintry weather, bound to introduce many serious problems, was fortuitously late in arriving. Fear of ice on Havel Lake caused the withdrawal of the Sunderlands on 16 December and they did not return, having been replaced by Celle's C-54s. Despite long hours of darkness and periods of bad flying conditions, the 50,000th landing at Gatow took place on Christmas Day. On 28 December the combined RAF/US/civilian delivery of freight so far totalled 700,172 tons, the outcome from 96,640 sorties. The 100,000th of those was flown on 31 December.

To reach Gatow, RAF crews usually flew towards the M/F beacon at Frohnau. Its transmissions to the aircraft's radio compass provided bearings during the flight along the northern corridor, a second beacon taking over near Berlin. Navigation assistance also came from *Eureka* beacon response to the aircraft's *Rebecca* emission showing to the navigator, on a radar screen, his bearing and distance from the beacon. The *Gee* chain was also available and 40 miles out from Gatow, Ground Control Approach radar could give the incoming aircraft's height, bearing and the distance from Gatow's runway. The airfield was one of the first to have sodium bar lighting, developed at RAE Farnborough and tested at RAF Lakenheath. Radar and radio aids played a major role in enabling operations during the long hours of darkness and when the weather in the corridors was bad. For reasons of safety the British now approached Berlin via the northern corridor,

High intensity operations demanded much airfield maintenance. German labourers are shown widening a landing strip. via Bruce Robertson

Avro Yorks on Gatow's apron. Note the airlift identity number applied to York 'KY-N', allowing easy recognition once on the ground. IWM

the Americans in the southern corridor and both participants generally flew home along the central corridor.

By January 1949, the RAF effort had almost returned to its earlier level. In August 1948, its daily average lift totalled 1,600 tons. That fell to around 840 tons in the autumn but by February 1949 had climbed to a daily average of 1,200 tons. Civilian loads averaged 112 tons daily in September 1948, 450 tons in November and 620 tons in January 1949. Various factors effected all the loads delivered and in February 350 tons was the daily level of civilian delivery. Late August 1948 found the total Allied lift running at about 4,000 tons daily, whereas by Spring 1949 it was averaging 7,000 tons daily.

Throughout the Berlin Airlift food was the main commodity carried to the city, the RAF aiming to convey 40 tons daily for the British troops of the Berlin garrison and 1,300 tons for civilians. Half the food delivered was flour, transported in favour of bread because the latter contained 30% water. Daily consumption of potatoes amounted to around 900 tons, a hefty total. To cope with that need 180 tons of dehydrated potatoes, the equivalent quantity, was supplied, calling for 80 return flights. Although sacks and card containers were used instead of heavy tins whenever feasible, reducing non-productive weight was not easy, and meat invariably had to be delivered in tins. Very little fresh milk was available in Berlin, most deliveries being of the dried type which was also the case with eggs. Salt was also needed, although its conveyance caused concern as any leakage could play havoc with an aircraft's structure. The problem was much reduced by carrying the large quantities needed in lined belly panniers of Handley Page Haltons, from where it could not easily enter other parts of the aircraft. The overall aim was to maintain 30 days food supply for everyone in western Berlin.

Newspapers played a major role in maintaining morale, which meant supplying newsprint. Shoes were needed in great quantities, and particularly children's shoes, to match their rate of growth. Fuel for transport, power stations and industry was in constant demand too. After completing 100 flying hours, an average of 40 Yorks and 60 Dakotas, returned each month to Britain for major overhaul by civil and military personnel.

Manufacturing and economic freight such as electrical goods, totalling about 1,500 tons a week, was brought out of Berlin, and mail travelled in both directions. Civilians with priority needs, the sick and many children were also flown out of the city, the RAF lift using Dakotas beginning on 19 October 1948.

The early weeks of 1949 brought some noteworthy achievements. On 18 February the 1,000,000th ton of freight reached Berlin aboard a York, and on 11 March the 50,000th civilian was flown out to Lubeck in a Dakota. At that time the combined monthly Allied lift reached a tonnage of 196,160. Next month it totalled 232,267 tons. On 16 April, a special all-out effort was mounted to discover what could be achieved during a 24 hour period. By despatching 2,764 flights an impressive 12,941 tons of freight was airlifted, achieved by having aircraft landing or taking off at the three airfields at the rate of one every two minutes. Such utilisation could not be sustained for long and next day a more normal 859 landings took place with 7,572 tons figuring on the load sheets.

By now it was becoming clear to the USSR that the blockade of Berlin was counter-productive, and indeed detrimental to their aim. Just how much so was obvious on 4 April 1949 when 12 nations, disturbed by Russian belligerence, signed the North Atlantic Treaty establishing NATO. On 5 May, agreement to lift the blockade was reached, and free surface access became available from 00.01 hr on 12 May 1949. That did not halt the airlift and in May the load delivered totalled 250,818 tons, part of which was for a stockpile against future trouble. On 30 June, the British delivered 2,263 short tons, their all-time record over a 24 hour period.

The wind-down took until 1 September when the Berlin Airlift Task Force closed down. By then an average of 130 RAF aircraft in use had delivered 23% of the freight flown to the city. The US commitment averaged 220 aircraft, to which C-47s, C-74 Globemasters and C-82 Packets were periodically added. British civil aircraft operations ended on 12 August, by which time they had airlifted 147,727 tons of freight and 90,000 tons of wet fuel, which they alone carried. Night delivery ended on 22 August, Dakota deliveries ceased the next day and Yorks were withdrawn on 29 August, when operations from Wunstorf also ended. Between 26 June 1948 and 12 May 1949 1,600,000 tons of freight was delivered, with an additional 713,000 tons subsequently flown in for stockpiling.

The financial cost of mounting the British contribution was reckoned to be have been about £200,000 a day in 1948 figures. In seven fatal accidents 23 British airmen lost their lives. Four involved RAF aircraft and three were civilian transports. Two of the former and one civilian aircraft crashed in the Russian Zone and in all cases the Soviet authorities acted most properly and humanely. There were nine USAF accidents in which 21 personnel and seven German passengers were killed. How many died in Berlin as a result of the blockade it is impossible to assess.

It is certain that nearly all who lived in Berlin during those hard times showed ever increasing respect for a democratic and free way of life, and were exceedingly grateful for the effort expended to succour them. Heading along a packed air corridor at night or in bad weather with limited navigation aids and then needing to accomplish a difficult landing – and flying home under just as taxing conditions – called for airmanship of a high order. That, the Royal Air Force and its civilian supporters displayed in plenty. Without doubt the Berlin Airlift may be regarded as a great epic in Britain's support of freedom.

* Note: all mention of tons relates to the short ton of 2,000 lb.

RAF SQUADRONS INVOLVED IN THE BERLIN AIRLIFT

Douglas Dakota IV equipped:
Home station Oakington: Nos 10, 27, 30, 46
Home station Waterbeach : Nos 18, 53, 62, 77

Avro York equipped:
Home station Abingdon : Nos 40, 59, 242
Home station Bassingbourn: Nos 24, 51
Home station Lyneham: Nos 99, 206, 511

Handley Page Hastings equipped:
Home station Dishforth/Schleswigland : Nos 47, 297

Short Sunderland V equipped:
Home station Calshot : Nos 201, 230

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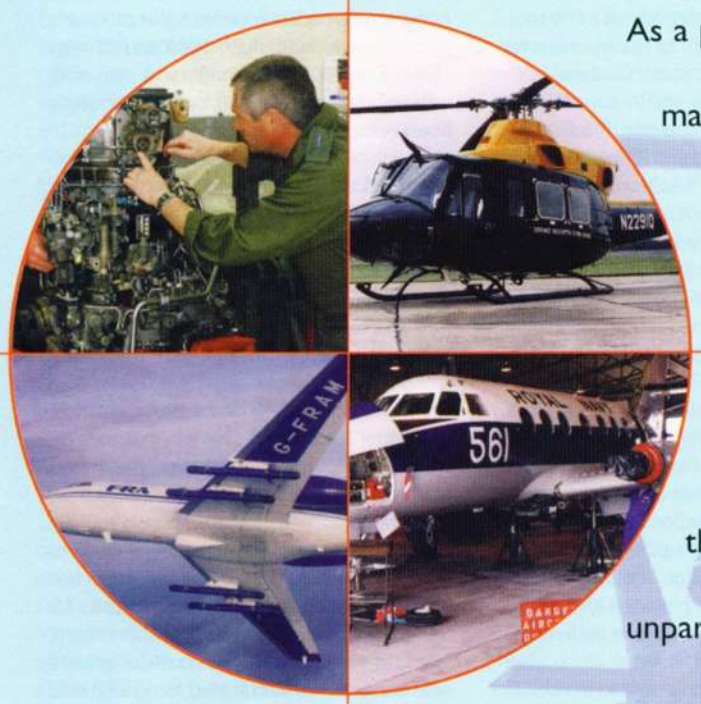

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Main picture: Prior to a sortie in a Griffin HT1, an RAF student pilot completes his pre-flight walkround watched by his instructor as the crewman instructor briefs his students.
All photographs Patrick Allen

Above: The well laid-out cockpit of the Squirrel HT1, equipped with VOR, DME and GPS. Right: Squirrel HT1s can carry six people although three or four is normal for training sorties.

Patrick Allen visits the new Defence Helicopter Flying School at RAF Shawbury.

On 1 April 1997, the Defence Helicopter Flying School (DHFS) was formed at RAF Shawbury, Shropshire and was formally opened nine days later by the Vice-Chief of Defence Staff, Air Chief Marshal Sir John Willis KCB, CBE, RAF. On 27 May the first course comprising five Army, three RAF and two RN students arrived for their pilot training and on 16 June, after attending three weeks of Ground School, their helicopter flying training began in the school's new fleet of Eurocopter AS350BB Squirrel HT1s. This was quite an achievement considering it had been less than three years since the concept of a single site for basic helicopter training, using contractor-owned and maintained aircraft, and a proportion of civilian flying instructors, was first conceived.

Prior to the establishment of the new tri-service DHFS, all three air arms undertook their own helicopter flying training. The RAF operated No 2 Flying Training School (2 FTS) at RAF Shawbury; the RN had 705 Naval Air Squadron at RNAS Culdrose and the Army Air Corps had 670 Squadron, the Basic Rotary Wing Squadron at Middle Wallop. All three squadrons operated the Gazelle, with the RAF also operating the ageing Wessex for its advanced flying training.

As a result of the 1994 Defence Cost Studies, which had a mandate to look into areas to cut costs and rationalise training operations, the concept of the DHFS was born. It was envisaged that this would be achieved by providing a single location, common syllabus, and involve private finance initiatives with aircraft being supplied, owned and maintained by a civilian contractor who would bear the majority of the risks. To further reduce costs the helicopters would be to civilian specifications and be maintained and operated to Civil Aviation Authority (CAA) requirements, although they would be military regulated and also receive military serials to reflect their military training requirements.

Having established that a single location and contractor-based operation were feasible, a hard-won competition was fought between several consortia to provide both helicopters and contractor operations. Two new training helicopter types needed to be acquired to replace the ageing military fleet of Gazelle and Wessex helicopters. This included a single-engined training helicopter, for basic and advanced training, and a twin-engined helicopter for multi-engine advanced training. The helicopters also needed to be suitable for additional search and rescue training and for operational training, required

by the Army Air Corps at Middle Wallop. The helicopter types would also be used by the Central Flying School (CFS), also operating from RAF Shawbury, with a number of helicopters required for instructor training over and above the DHFS requirement.

After an intensive fly-off competition the Eurocopter Squirrel AS350BB, designated the Squirrel HT1/HT2, and the Bell 412EP, designated Griffin HT1, were finally selected. These helicopters, together with maintenance and 40% of the flying instructors, would be provided by FBS Limited, the winning contractor. This was a new consortium between Flight Refuelling Aviation (FRA), Bristow Helicopters Limited and Serco Defence. Operating on a 15-year contract they provide 22,000 flying hours per year and 40% of the Instructors, who must all be ex-military and trained to Central Flying School (CFS) standards. The contractor would also provide two Squirrel HT1 cockpit Procedural and Instrument Heli-Trainers, a Griffin Cockpit Procedural and Instrument Trainer and a full motion Griffin HT1 Flight Simulator with an advanced visual system.

RAF Shawbury

Having looked at several locations, RAF Shawbury – that had been home to RAF flying training since 1938 and helicopter flying training since 1976 – was considered ideal for the new DHFS. Long time home of the RAF's Central Air Traffic Control School, Shawbury provides modern radar and approach aids and is central to its own dedicated low flying area and clearings. It is also adjacent to a mountain flying training area, all ideal for developing specific skills. Two relief landing grounds at RAF Ternhill and Chetwynd are both within ten nautical miles of Shawbury. Ternhill, as well as providing an ideal satellite airfield for basic aircraft handling and circuits, also provides additional refurbished training facilities and a precision approach radar.

The DHFS is fully tri-service in nature, but for administrative and budget purposes, is established within the RAF Command structure under the AOC-in-C, Headquarters, Personnel & Training Command. For day-to-day control and discipline it is under the control of the Commandant DHFS, who alternates between the RAF, RN and Army every two and a half years. The first and present Commandant is Colonel Michael O'Donoghue (AAC). Training objectives and course numbers are set by a Joint Services Group reporting directly to the Chief Executive, Training Group, Defence Agency at Headquarters, Personnel & Training Command. The DHFS mission is to deliver this training output, developing syllabuses and courses as required, to meet the needs of the Navy, Army and RAF.

Currently, the DHFS trains approximately 275 students a year, including navigators, crewmen and post graduate students from all three services, plus a small number of foreign and Commonwealth students. New courses start each month and during the first year student throughput numbers have been 31 RN, 82 AAC, 44 RAF pilots, ten RAF navigators and 20 RAF crewmen, seven Royal Marines, ten overseas and 71 miscellaneous students – the latter including refresher training and type conversions, RAF Harrier pilot rotary wing familiarisations, test pilot, Royal Marine aircrewmen, RN Instrument Instructor courses and senior officers' familiarisation courses.

Squirrel HT1/HT2

The Eurocopter AS350BB Squirrel HT1/HT2, powered by a single Turboméca Arriel 1D1 gas turbine engine, driving a conventional three blade main rotor and twin-bladed tail rotor, was chosen as the single-engine basic, and single-engine advanced rotary wing trainer. The Squirrel provides an excellent lead-in to helicopter flying for pilots from all three services and is well suited to the single-engine advanced course, which includes night and instrument flying. With a cruise speed of 126kt (145mph), the Squirrel is fully equipped for military IFR operations with NAT radios (two x UHF, VHF, TAC FM/UHF on HT2) Radalt, Bendix/King VOR/DME (HT1 only), GPS etc and can carry six people. It can also be fitted with a winch and FLOT gear for winching and mountain flying training required for RN students.

There are two variants of the Squirrel, the HT1 used by the DHFS at Shawbury and the HT2 variant used at Middle Wallop for AAC Operational Training with No 670 Squadron. Apart from the avionics fit, the other differences in the HT2 are minor; being principally NVG compatible cockpit lighting, an underslung-load hook and a Brightstar floodlight. Squirrel HT1 daily requirements at Shawbury are for approximately 19 Squirrels for DHFS training and six for the CFS(H) Squadron. Twelve Squirrel HT2s are based at Middle Wallop to support the Army's Operational Development flying training phase.

Bell 412EP/Griffin HT1

For multi-engine advanced rotary wing training, the Griffin HT1 is the UK military version of the Canadian manufactured civilian Bell 412EP powered by two Pratt & Whitney Canada PT6T-3D Turbo Twin-Pacs rated at 1900shp which drive an advanced design four bladed main rotor. The Griffin has replaced the ageing Wessex as the RAF's multi-engine advanced rotary wing training helicopter and is used to train RAF pilots, navigators and crewmen. Capable of carrying six people in comfort, the Griffin is an ideal training platform, with the cabin capacity for multi-crew training sorties. A typical crew composition for a training sortie would be three students (pilot, navigator and crewman) and two instructors.

Above: The crew complete their pre-flight checks before a training flight in one of the DHFS Griffin HT1s.

Left: Signing out a Squirrel HT1 for a training sortie at 660 Squadron.

The Griffin has a comprehensive suite of avionics and navigation aids, again to CAA standards for single-pilot IFR operations and is ideal for procedural instrument flying and SAR training. The Griffin has been fitted with NVG compatible cockpit lighting and can be flown by a single pilot. It has a cruise speed of 122kt (140mph) with an endurance of approximately three hours and a maximum take off weight of 11,900lb (5397kg). The DHFS normal requirement is for six Griffin HT1s at Shawbury and three with the Search and Rescue Training Unit (SARTU) at RAF Valley, although one of these is available to Shawbury when required.

Training

The majority of Navy and Army students arrive at the School having completed the Joint Elementary Flying Training School at RAF Barkston Heath (RN) or RAF Newton

(Army), where they will have flown the Slingsby T67 Firefly. In the future RAF students will arrive from University Air Squadrons where they will have undertaken their Elementary Flying Training. All flying training at DHFS is to Central Flying School standards of instruction, with the DHFS having its own internal Standards and Examining Officers, who are agents of the CFS. Training is continually inspected by CFS Examiners to make sure that standards remain as high as possible.

After a detailed Joint Services study it was found that only 35 hours of basic flying training was common to all three services. There would then be differences in the respective training programmes. To meet this need end, the DHFS established a Ground Training Squadron and three Flying Training Squadrons at RAF Shawbury, plus SARTU at

Above: A student and instructor with a 660 Squadron Squirrel HT1.

Above: Squirrels are used for both basic and advanced single engine rotary wing training which includes formation, instrument and night flying.

RAF Valley. All the squadrons have tri-service and civilian instructors. As part of their flying and military education students are introduced to the traditions of the other services and the three flying squadrons, although fully tri-service, are each run on Army, Fleet Air Arm and Royal Air Force squadron principles. This gives students a brief insight into how other services operate.

Ground Training Squadron

DHFS has modern classrooms and lecture facilities for ground training and prior to commencing flying training, students attend three weeks of ground training. The principal subjects covered are helicopter technical instruction on the Squirrel HT1, helicopter principles of flight, meteorology and navigation. Students are tested at the end of the third week to ensure that they have met the minimum criteria laid down by their respective UK or overseas service. At the end of their Single-Engine Basic Rotary course students spend another week at the Ground Training Squadron. For those attending the Multi-Engine Advanced Rotary Wing course they spend a further three weeks in the classroom.

Single-Engine Basic Rotary Wing Squadron (660 Sqn)

The Single-Engine Basic Rotary Wing Squadron has the Army Air Corps designation 660 Squadron. Operating the Squirrel HT1, the squadron is commanded by an Army Major with instructors from all three services and FBS Ltd. Based in new purpose-built instructional buildings at RAF Shawbury and Ternhill the squadron provides 'one on one' tuition where students undertake eight weeks of training, flying 35.5 hours, of which eight are solo. The syllabus covers all aspects of basic instruction including: effects of control, hovering, circuits and more advanced handling techniques including engine-off landings, low-level flying, quickstops and simulated emergencies. All pilots undertake the same syllabus with No 660 Squadron before moving on to 705 Squadron.

Single-Engine Advanced Rotary Wing Squadron (705 Sqn)

This squadron bears the designation of 705 Naval Air Squadron, the former Royal Navy Helicopter School, and is commanded by a Royal Navy Lieutenant Commander, and like 660 Squadron is tri-service in nature. This is the largest of the DHFS squadrons and on completion of their training with 660 Squadron, plus a further week at ground school, students join 705 Squadron to develop their pure flying skills, again on the Squirrel HT1. This training consolidates their previous flying skills and includes an introduction to instrument flying, navigation, confined areas and reversionary night flying.

The number of training hours differs between the three services at 705 Squadron. Navy pilots fly 46 hours in 12 weeks, Army pilots 33 hours in nine weeks and RAF pilots 22 hours in five weeks. RAF students then move to 60 Squadron for their Multi-Engine Advanced Training. Army students go to Middle Wallop to fly the Squirrel HT2 on their Operational Flying Phase and Royal Navy and Foreign and Commonwealth students continue with 705 Squadron to cover formation flying, winching and mountain flying training with SARTU. 705 Squadron also undertakes miscellaneous training including aircraft conversions, refresher courses, RM crewman courses, Harrier pilot familiarisation and RN Instrument Instructor's courses. RAF navigator and crewmen lead-in courses are also carried out by 705 Squadron. They comprise five hours flying in the Squirrel HT1 as an introduction to helicopters, prior to joining 60 Squadron.

Multi-Engine Advanced Rotary Wing Squadron (No 60 Sqn)

The Multi-Engine Advanced Rotary Wing Squadron is commanded by an RAF Squadron Leader and operates as No 60(R) Squadron. RAF students stay at Shawbury for their multi-engine training on the Griffin HT1 and are the only students to receive their 'Wings' at the DHFS. Apart from pilots, the squadron trains RAF navigators and crewmen. Following two weeks at Ground School, students spend 25 weeks with 60 Squadron flying 66 hours in the Griffin.

The training syllabus is split into four training modules – basic, advanced, tactical/ mission management and search and rescue

training. All sorties make the maximum use of flying hours and sorties include pilot, navigator and crewman instruction. The Griffin HT1 simulator will be used to good effect during many of the training profiles, which includes iInstrument and procedural training, emergencies and tactical flying skills, including Night Vision Goggle (NVG) operations.

The Basic Module includes type conversion and basic handling, circuits and emergencies, sloping ground and low-flying navigation exercises and ends with a Basic Handling Check, before moving to the Advanced Module. This includes skills such as underslung load operations and emergencies, low level navigation exercises (Navex) and confined areas, a rapid-plan Navex, rapid-plan return to base Navex, instrument flying and consolidation, leading to night flying and night underslung load lifting, night Navex, mountain flying and close formation.

The Tactical/Mission Management Module sees students deploying away on a tactical detachment as they are introduced to Support Helicopter Operations including NVG operations. Skills include concealed approach and departures, low-level tactical flying, advanced handling skills, tactical formations, underslung load lifting within a tactical environment and operating within a tactical and operational scenario, which requires rapid mission planning and re-tasking in flight etc. This module is designed to consolidate all their previous training and to help prepare them for their operational conversion and tactical missions within the RAF Support Helicopter Force. At the end of this module RAF students move to RAF Valley for their SARTU training, which is also part of the DHFS syllabus.

Search & Rescue Training Unit

At SARTU RAF students spend three weeks flying 12 hours in the Griffin undertaking SAR training. This includes maritime and over sea, cliff and boat deck winching (including high-line winching techniques) and mountain flying training. RAF Valley provides an ideal location for this type of training being geographically well placed adjacent to the sea and shipping lanes, a harbour, cliffs of varying height and the mountains of North Wales. Their training at SARTU further helps students to develop their multi-crew operations. Three Griffin HT1s have been fitted with winches and FLOT gear for this role. SARTU Instructors are all from the RAF and FBS Limited. In addition to the DHFS students attending Module 4 of the multi-engine advanced course, SARTU also trains aircrew for 11/18 Group tasks, mainly SAR crew selection and pre-Sea King OCU courses. SARTU also hosts detachments from 705 Squadron carrying out the winching part of their course.

The training syllabus has been specifically tailored to suit the requirements of the individual services and the School has the best instructors from all three services along wih their ex-military counterparts.

At the end of their SARTU course RAF students return to Shawbury to receive their 'Wings' at the DHFS before moving to their Operational Training Squadrons flying either the Wessex, Sea King, Chinook, Puma or when it enters service, the Merlin HC3.

As commented by Colonel O'Donoghue, "The DHFS is very much a tri-service operation and although operating contractor-owned and maintained helicopters with a proportion of civilian flying instructors, the DHFS is firmly a military school, with flying instruction not the sole aim". The School has been able to adopt the very best training practices taken from all three services and benefits from a modern training helicopter fleet. The training syllabus has been specifically tailored to suit the requirements of the individual services and the School has the best Instructors from all three services along with their ex-military civilian counterparts. The School is supported by a modern and comprehensive infrastructure provided by RAF Shawbury and provides a training package second to none.

By early 1998, the first DHFS students arrived at their various operational training units and everyone at the DHFS awaited the verdicts of those training staff with keen interest. Whatever the reaction, the goals of the DHFS will remain – 'Aiming For Excellence'.

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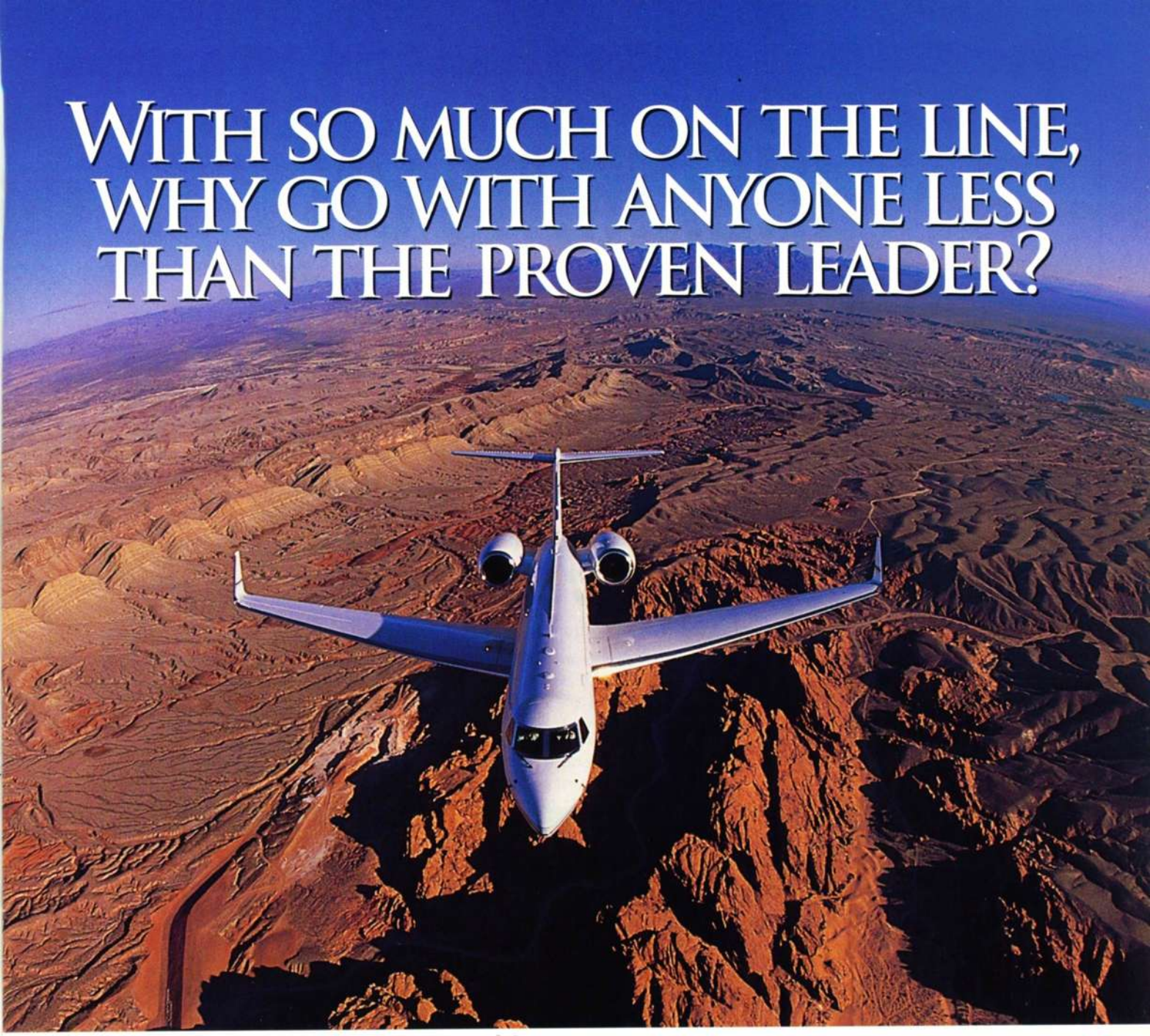

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UNTIL EUROFIGHTER:1

Jon Lake takes a look at the Tornado F3 Capability Sustainment Programme.

There are those who have criticised the RAF's continuing reliance on the Tornado F3 for air defence duties. A black picture has been painted of an aircraft which (they aver) lacks high altitude performance and which does not have the agility necessary for close-in dogfight engagements. Critics of the aircraft have pointed to the way in which the Tornado was 'sidelined' during Operation *Desert Storm*, claiming that it was kept in friendly skies for its own safety – whereas in fact, the aircraft's lack of fully USAF-compatible IFF, compatible secure voice radios and datalinks were the cause of its confinement. Interestingly, USN F-14s were subject to much the same restrictions. It was the danger of fratricide rather than the danger posed by Iraqi fighters which led to restrictions being imposed on the Tornado. But whatever the reason, the Tornado F3's lack of participation in *Desert Storm* dented the aircraft's credibility.

The truth is that the Tornado F3 remains a very much more capable aircraft than has sometimes been realised. Recent dissimilar air combat training exercises against a wide range of opponents (including USAF F-15s) have validated the RAF's confidence in the aircraft and its crews. By using the right tactics, in conjunction with AWACS support and JTIDS, the Tornado F3 crew can exploit the strengths of their aircraft, while simultaneously preventing the enemy from taking advantage of the type's weaknesses.

While *Desert Storm* resulted in the F3 gaining something of an undeserved reputation, there is little doubt that the aircraft does have weaknesses. Since the Tornado Air Defence Variant first entered service, in its trouble-prone F2 form, there have been plans and proposals for a variety of updates and upgrades. The emergence of the Su-27 'Flanker' as an escort fighter capable of reaching UK airspace starkly revealed the limitations inherent in the original long-range, all-weather, bomber destroyer concept. Replacement of the historically troublesome Foxhunter radar has been a long-standing element in the succession of stillborn upgrade plans for the Tornado ADV, with the Hornet's AN/APG-65 and Sea Harrier F/A-2's Blue Vixen being the usual candidates. Today, pressure to replace the original Foxhunter has abated somewhat, although all in-service F3s will have a common radar (Stage 2G) by the end of the century.

The Tornado F3 has long been regarded as being rather lacking in power. This is an inevitable result of having been based on the IDS Tornados, whose engines were optimised for low level flight, offering relatively high thrust and low specific fuel consumption at relatively modest supersonic and high subsonic speeds at low altitudes. Thrust fell off dramatically as altitude increased, while fuel consumption rose alarmingly at higher cruising speeds. In short, the RB199 was far from being an ideal 'fighter powerplant', and its limitations have had a far-reaching effect on Tornado F3 tactics and procedures. Combat Air Patrols are usually flown at much lower altitudes (20-25,000 ft) than was the norm in Lightning days, for example.

Recent dissimilar air combat training exercises against a wide range of opponents – including USAF F-15s – have validated the RAF's confidence in the Tornado F3 and its crews.

The Tornado powerplant does offer excellent performance at low level, where the Tornado offers genuine 800 kt capability. The RB199s also confer an eye-watering lower airspace combat climb performance, and acceleration at low altitudes is very impressive. But thrust improvements would be greatly appreciated on the F3 force (find any fighter pilot who wouldn't like more thrust!) and could be relatively easy to provide. Greater mass flow could be provided, and higher operating temperatures could be permitted, if the engine received new seals and new materials in certain areas, and if the new 62B fan was fitted. About 15-20% extra thrust could be provided 'affordably', and though unlikely, there is still the theoretical possibility of re-engining with the Eurofighter's EJ200 engine.

The entry into service of the American AIM-120 AMRAAM, and the forthcoming deployment of the similarly capable Russian R-77 (AA-12 'Adder', once dubbed 'Amraamski') has underlined the shortcomings of the Tornado's primary air-to-air missile armament. SkyFlash was an excellent weapon in its time, and remains viable in most scenarios even today. However, by today's standards, there can be no argument that the missile has a relatively modest range and its reliance on semi-active radar guidance (inferring target illumination by the launch aircraft throughout the missiles flight) is increasingly unacceptable. This latter factor prevents the Tornado F3 from turning and running away until the missile impacts (or misses), since the F3 pilot must keep the target within his radar 'gimbal' so that the target remains 'illuminated'. This effectively prevents engagement of another target, and renders the Tornado vulnerable to a return missile shot. A genuinely 'fire and forget', 'launch and leave' missile would overcome that disadvantage, of course, as would a missile with active terminal guidance. The development of an Active SkyFlash came to nothing, and it soon became apparent that what the F3 needed was the American AMRAAM.

The Tornado F3's defence of the UK Air Defence Region during the Cold War did not require a particularly accurate autonomous navigation/position finding capability. The aircraft had to be able to find its way home in all weathers, but could rely to a certain extent on AWACS and ground radar to find its CAP stations and targets. This tended to obscure the obsolescence of the aircraft's INS-based navigation system. With the end of the Cold War, and with the adoption of greater out-of-area responsibilities, the aircraft has adopted a new navigation system, based on a ring laser gyro INS and Global Positioning System (GPS). This gives accurate worldwide position and time reference allowing better radar track correlation and helps ensure optimum time-sharing in data links.

However well the Tornado F3 seems to deal with current threats today, it would be unpardonably complacent to assume that the aircraft could continue in service indefinitely without modification or upgrade. An initial plan to equip the F3 with AIM-120 AMRAAM and AIM-132 ASRAAM was cancelled as an economy measure in 1992, and by 1995 there

Above: The F3's lack of participation in *Desert Storm* dented its credibility, but it is a very much more capable aircraft than this suggests. Geoff Lee/BAe

Recent improvements to the F3 have included fitting Vinten Vicon 78 flare dispensers (left), being demonstrated by a Tornado F3 of No 111 Squadron (above). Paul jackson/Geoff Lee

was considerable pressure on the RAF to acquire surplus (by lease or outright purchase) of ex-USAF F-16s to bridge the gap pending the introduction of the Eurofighter, whose in-service date continued to slip.

While the F-16 is a very fine aircraft (and a superb close-in dogfighter and tactical fighter), it has only the most rudimentary BVR (beyond visual range) capability, and its *single-seat, single-engined configuration* does not ideally suit it for the kind of long-range (often over-water) BVR operations which form the basis of the RAF's air power doctrine. Moreover, the F-16's lack of probe-and-drogue refuelling capability and reliance on US-style logistics and support infrastructure would have required considerable investment, while the RAF's possession of an agile single-seat fighter might have raised difficulties in justifying procurement of the Eurofighter.

Plans to equip the Tornado F3 with AMRAAM and ASRAAM were cancelled in 1992, but were reinstated as part of the 1996 Mid-Life Update programme.

The Tornado modernisation (originally referred to as a Mid-Life Upgrade or MLU) was announced on 5 March 1996, when it was revealed that BAe would be the prime *contractor in a £125 m contract aimed at* extending the service life of 100 F3s to 2010. The key items of the upgrade were the provision of a MIL STD 1553B digital databus and AMRAAM and ASRAAM capability.

The programme therefore includes provision of a changed main computer processor (allowing communication between the new missiles and the aircraft), a new missile management system (with updated ADA software), and improved display graphics (on the existing display screens). Remarkably no new AMRAAM missiles are to be procured, with the Tornado force taking missile rounds originally procured for the Royal Navy's Sea Harrier FA2. Similarly, ASRAAM missiles will be taken from stocks originally procured for the Harrier GR7. Only a relatively limited number of SkyFlash launchers will be procured, and these will be fitted to the F3 Capability Sustainment Programme (CSP) aircraft on an as-required basis, with most aircraft retaining SkyFlash launchers for most of the time. The AIM-9 Sidewinder and ASRAAM will be able to use a new common launch rail, and this will integrate Celsius Tech BOL-304 chaff dispensers, like those being fitted to the Harrier GR7 and Jaguar GR3.

Another driver behind the CSP is to bring all RAF Tornado F3s to a common ergonomic standard, getting away from the 'Mini Fleet' situation already plaguing the GR1/GR1A/GR1B force, and threatening to become a problem in the F3 world. The CSP modifications are not the only changes being incorporated in the Tornado F3, however. The Gulf War saw the incorporation of a number of improvements by use of the STF (Special Trials Fit) and SEM (Service Engineering Modification) procedure, rather than by using the Design Authority Modification route.

Improvements included radar and engine modifications, the incorporation of AN/ALE-40 (and later Vinten Vicon 78) flare dispensers, Phimat chaff dispensers and the addition of Radar Absorbent Material (RAM) and Surface Wave Absorbent Material (SWAM) on leading edges to reduce frontal radar signature. A Night Vision Goggles (NVG) compatible cockpit has also been developed and incorporated. In August 1997, for example, it was announced that 115 Elmer SRT-651N V/UHF twin-unit *Have Quick* frequency hopping radios (packaged by GEC) have been purchased for the Tornado F3 fleet. *Have Quick* is jam resistant and has a greater level of security through its frequency hopping, but is not a cryptographic radio, with no chopping and rebuilding of the transmitted and received signals.

Quite separately from the CSP package of modifications the Tornado F3 will continue to receive further improvements. There is a requirement for the aircraft to gain new LCD display screens, though this may not have been formally stated. An IFF upgrade is

reportedly 'in the pipeline', while it has been acknowledged that a Towed Radar Decoy (TRD) has been deployed on Tornado. GEC's Aeriel TRD was first deployed operationally on Nimrods during Operation *Granby*, and was soon refined and adapted for carriage on fast jets. By 1995 it was revealed that the system had been used successfully by Tornado F3s flying over Bosnia. The present TRD cannot be reeled-back onto the aircraft, but can be jettisoned over the airfield (or some other pre-briefed point) for recovery (by parachute) and re-use.

JTIDS (Joint Tactical Information Distribution System) was originally envisaged as a means of allowing the kind of massive multi-bogey engagements expected in the Cold War, giving all participants in the air battle a single, recognisable picture of the air situation. Although the threat of such action has receded, a tactical data link remains a vital piece of equipment, dramatically improving the situational awareness of the air defence fighter aircrew, and allowing the kind of stand-off BVR engagement for which the Tornado ADV was originally designed. The Tornado ADV was always intended to be fitted with JTIDS Link 16, but development of the system was delayed considerably.

The Tornado's two-seat configuration, relatively large size and relatively roomy cockpit allows it to carry the Class II JTIDS terminal, which is regarded as being crude, but the first real production standard tactical data link. It is a large terminal (too big to fit into an F-16, for instance), but has a high level of capability. The Class II JTIDS is probably superior to the more recent NATO-designed MIDS, which is of smaller size, and which is lighter in weight, and is also superior to the US JTIDS 2R, the lightweight fighter terminal fitted (for example) to the Sea Harrier. Every Tornado F3 is now wired to allow the carriage of JTIDS terminals, but relatively few aircraft actually carry the JTIDS Line Replaceable Units (LRUs). At the end of the day, provision of JTIDS for the Tornado has been a great success story, and the Tornado force is confident that it has the best JTIDS set-up there is.

The CSP flight trials programme began in January 1997, involving three Tornado F3s in use with BAe as long-term test aircraft. All are already fully instrumented for trials and test duties with comprehensive wiring for various items of flight test instrumentation. The first of the CSP support aircraft is ZG797 (AS145) which is already flying with software for the CSP's new displays. None of the test aircraft will be a CSP prototype as such, though ZE155 (AS011) will come closest. Assigned to missile carriage trials this aircraft (the first F3 without dual controls) will eventually be modified to virtually full CSP standards, although it will not be returned to the RAF and will remain in Warton's long-term test fleet. The aircraft is scheduled to join the test programme in February 1998. Finally ZD899 (AT001) will fly (from February 1998) as a radar target aircraft.

BAe working parties will modify the first 24 CSP aircraft at RAF St Athan, but the next 76 will be modified by RAF personnel using BAe supplied kits produced at Salmesbury. All 100 aircraft will be modernised and returned to service by 2001. This is regarded by BAe as being a remarkably abbreviated timescale, with the aircraft being delivered in about half the normal time. Although the CSP modifications will dramatically transform the capabilities of the Tornado F3 the type will continue to operate under the existing F3 release to service, and therefore no new designation is being allocated to the modernised aircraft.

Although some 100 F3s are being upgraded to CSP standards, it seems likely that not all will be equipped with all of the key LRUs associated with the full standard CSP aircraft. It is believed that only enough JTIDS sets, AMRAAM missiles and AMRAAM launchers will be procured to equip 'two squadrons... sufficient to fulfill the needs of a rapid-reaction force'. Most of the modernised Tornados will thus 'soldier on' armed only with the semi-active radar homing SkyFlash.

On test at Warton in 1995, F3 ZE161 carries a Towed Radar Decoy on the port outer pylon. Terry Senior

The modest package of improvements which constitute the CSP programme will not transform the Tornado F3 into an agile dogfighter, nor will they do anything to improve high altitude performance. But they will dramatically improve the aircraft's survivability and BVR air combat capability, and they should ensure that the aircraft can remain viable until the Eurofighter enters service.

UNTIL EUROFIGHTER:2

Peter R Foster visits the Tornado F3 Operational Evaluation Unit.

Traditionally it had always been the responsibility of the test establishments to examine and evaluate new platforms and systems before passing them on to front line squadrons to undertake operational trials. This arrangement has worked quite well in the past but, as systems have become more complex, as integration issues have become more important and as the number of frontline units has reduced, this test and evaluation format proved inadequate to achieve the best product.

This has been particularly noticeable when new systems have entwined with the introduction of new platforms, resulting in the unit's initial operating capability (IOC) being delayed or the development of weapons and systems falling behind. To overcome much of this, the Air Warfare Centre (AWC) has gradually undertaken greater co-ordination of such activities in service, employing a number of small units tasked with specific systems development and the creation of several operational evaluation units (OEUs) equipped with front-line aircraft to undertake the tactical development phase. Development flying to

Upgrading the 'historically troublesome' Foxhunter radar has been a priority for the Tornado F3 improvement programme, and has given the F3 OEU considerable trials work.

prove and clear a type for service has however remained in the hands of the former test establishments of the Defence Evaluation and Research Agency (DERA) and the manufacturer.

Under the control of the Air Warfare Centre (AWC) at RAF Waddington, the Tactics and Electronic Warfare Division (T&EW) exercises functional control over a number of RAF flying units, including the Strike Attack Operational Evaluation Unit (SAOEU) equipped with the BAe Harrier GR7, Panavia Tornado GR1/4 and SEPECAT Jaguar GR1B/3, located at Boscombe Down; and the Tornado F3 Operational Evaluation Unit (F3 OEU) based at RAF Coningsby. Other OEUs have been established and others continue to be set up as and when necessary for system/platform development.

The F3 OEU is ideally placed at Coningsby to gain the maximum support of a frontline Tornado base and convenient proximity to the E-3D Sentry community at Waddington. Wg Cdr C G Marrison has under his command in the F3 OEU, four Tornado F3s and crews. The unit is self contained with all of the necessary support personnel but enjoys the broader logistic backup offered by the station. Unlike the DERA-based unit, where pilots and navigators are predominantly from a test pilot background, at Coningsby all of the OEU crews are fresh from frontline tours, a significant proportion are Qualified Weapon Instructors, and all maintain a combat ready status. Qualification from a test pilot school or an aerosystems background is not usually a pre-requisite although it can be an advantage. This helps the evaluation process by having crews that have current tactical thinking and experience in which to develop the application of new weapons and systems.

Formed on 1 April 1987, under the command of Wg Cdr Mal Gleave, the F3 OEU was the third RAF unit to receive the latest Block 11 Tornado F3s, following on from No 65(R) Squadron/229 OCU and No 29 Squadron of the Coningsby Wing. Assigned F3s ZE210, ZE251 and ZE252 initially, there was a high turnover of aircraft to ensure that the OEU operated those at the highest modification state. These three F3s were exchanged for Block 12s (ZE729, ZE730 and ZE731) in December 1987, and in turn by Block 13s (ZE862, ZE888, ZE889 and ZE911) in February 1989. This brought the unit to the establishment of four aircraft that it currently maintains.

The F3 OEU is ideally placed at Coningsby to gain the maximum support of a frontline Tornado base and convenient proximity to the E-3D Sentry base at Waddington.

The role of the F3 OEU is to develop tactics and operational doctrine for the Tornado F3 force with the evaluation of systems forming an integral part of that role. It accomplishes this by spearheading tactical thinking, working closely with the operational front line units and the industry base, particularly British Aerospace, GEC-Ferranti, and EASAMS.

Tne unit's vital role was underlined following the invasion of Kuwait by Iraqi forces in August 1990 when the RAF had to deploy Tornado F3s to the region with the Type Z AI-24 radar. These aircraft were soon replaced by aircraft with the Stage 1 version with its revised cooling and new software. Before the Air War commenced in January 1991, these had been replaced by Stage 1+ aircraft, an interim upgrade that combined a series of modifications intended to enhance the F3's combat capability and survivability. These tactical enhancements, together with modifications that allowed the aircraft to operate in the Gulf's harsh climatic conditions, had been championed by the F3 OEU in the months leading up to hostilities commencing.

Addition of much of this new and improved equipment was the result of the ongoing trials being undertaken by the unit. Marconi upgraded the Stage 1 radar further to improve operational performance and enhance capability in the close-in dogfight. Improvements to the RHWR were made with upgrades to the software to recognise all potential threats and all in-theatre friendly forces and *Have Quick* secure radios were also fitted. In spite of all these improvements the F3 was employed only on Defensive Counter Air (DCA) tasks and restricted to operations over friendly territory. Although Offensive Counter Air (OCA) roles in support of air-ground assets was considered, the F3 was not tasked with such, mainly due to the availability of the better equipped F-15C.

Whilst the emphasis of impending hostilities released the necessary funds for these upgrades and industry and the RAF worked feverishly to retro-fit a number of aircraft, much of the work could not have been undertaken without the trials that had been ongoing at Coningsby and the value of the OEU's work on this occasion alone proved its worth.

The last six years have seen the programmes assume the more normal pace of development and trials. Funding has not been the biggest player, although finance does have an effect on the onward distribution. As far as the unit is concerned time is its biggest enemy. That apart, much of the current work centres around the development of new systems and as a consequence each of its four current F3s (ZE756, ZE830, ZE942 and ZE982) are invariably at different modification states. ZE982, the 'fleet leader', was one of the first aircraft to have the Stage 2 radar and is also equipped with the British built Vinten Vicon 78 series 210 chaff/flare dispensers that replaced the hastily added Tracor AN/ALE-40(V) for *Desert Storm*; and the Celsius Tech BOL integral chaff/flare dispenser and launcher pylon that has replaced the LAU-7. The rear of the BOL pylon carries the countermeasures whilst the bulbous nose contains the missile seeker-head coolant. The system replaces the ageing Philips-Matra 'Phimat' pod carried on a LAU-7 launcher rail in place of an AIM-9 Sidewinder missile and is both more efficient and user friendly as well retaining a weapon station. This aircraft also has the re-activated outboard underwing hardpoints with Tornado GR1-type outer wing pylons. This enables it to carry the GEC-Marconi Radar and Defence Systems Aeriel Towed Radar Decoy (TRD), presenting enemy surface-to-air and air-to-air missiles with an alternative target.

This latest modification was again the result of potential hostilities, this time over Bosnia. During 1995 a pair of Leeming-based Stage 1+ Tornado F3s were fired upon by SA-2 and SA-6 missiles. This and other incidents revealed some shortcomings in the aircraft's defensive suite that resulted in the successful systems adoption in the F3.

Although work commenced in 1986, actual trials did not start until eight years later. However, as a consequence of the F3 OEU's

Photographed over the California desert landscape, F3 ZE968 carries a GEC-Marconi Aeriel Towed Radar Decoy (TRD) on its re-activated outer wing pylon.

A formation of F3 OEU Tornados, including two aircraft brought in from frontline squadrons, that took part in JTIDS trials flown from NAS Oceana last October. Peter R Foster

presence and impetus when a need arose, the tactical application and aircraft interface problems had already been tested. Work however still continues in all three of these defensive aids applications, along with the Joint Tactical Information Distribution System (JTIDS). Once fully integrated, the system, which allows the downloading by data-link of the big AWACS picture and other facets, gives the crews enhanced situational awareness, allowing the Tornado to operate more effectively and with greater tactical options.

Initial JTIDS service trials were undertaken by the OEU during a major test on 27 October 1993, during which data was successfully transferred back and forth between two Tornado F3s, two RAF Boeing Sentry AEW1s and a pair of French Air Force E-3F Sentries. This was followed by further interoperability trials in the US during July 1994 in conjunction with USAF McDonnell Douglas F-15Cs of the 366th Wing at Mountain Home AFB, Idaho.

The application of JTIDS is one of the F3 OEU's current priority tasks. During October 1997, it deployed to the United States to undertake a series of JTIDS trials with elements of the US Navy and the resident Grumman F-14D Tomcat Squadrons at Oceana Naval Air Station, Virginia Beach. The system has been in operation with the American forces for a number of years. Part of the trial was to examine US Navy doctrine and experience and to see how the operating procedures currently in use can be adapted to suit multi-national interoperability. Wg Cdr Marrison found, however, that JTIDS was in 'short supply' in the US Navy's F-14 squadrons and its use relied predominantly on control being retained by the tracking aircraft, with only limited tracks being assigned rather than allowing the fighters to exploit the full picture air situation awareness to their best ends as is the RAF doctrine. Both he and his crews remain very enthusiastic as to JTIDS' further potential, which it is felt will overcome many of the Tornado F3's shortcomings in a fast moving war.

The Tornado F3 has, in Wg Cdr Marrison's view, been somewhat underrated, but since steps have been taken to exploit its true potential, it will be able to play an increasingly effective role in meeting the RAF's fighter air-defence requirements until the Eurofighter Typhoon FGA1 is in squadron service. It is therefore essential that its operational development continues to keep pace with changes in today's high-tech, fast-moving environment. The work of the F3 OEU is therefore a key to its future success.

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Anneka achieves the 'impossible'

Paul Jackson describes how an urgently needed Nimrod R1 was converted in record time.

Above: This view of XW666 shows many of the Nimrod R1's special features, including the radomes mounted on its tailcone and external wing tank fairings, antenna pods on each wingtip and hook antenna arrays on the top of the fuselage. Peter R Foster

Inset: The battered fuselage of XW666, which was recovered from the Moray Firth following its ditching in May 1995.

Pictures of the ditched Nimrod taken (by the RAF rescue Sea King) shortly before it slipped beneath the waves appeared in all the TV news bulletins and in the next day's newspapers. During a test flight after an overhaul at Kinloss, a serious double engine fire had forced the aircraft to ditch in the Moray Firth – perhaps the first such water landing ever by a land-based four-jet. The pictures prompted well-deserved praise for the skill of the pilot, although in some Whitehall offices, congratulations were not the most important item on the following day's agenda.

The aircraft lost was no 'ordinary' maritime patroller, but one of the three very differently equipped Nimrod R1 electronic reconnaissance aircraft flown since 1974 by No 51 Squadron. The unit, which had only just moved to RAF Waddington from its previous long-time base at Wyton, had performed valuable work during the Cold War, yet had been far from idle since the demise of the Warsaw Pact. According to NATO press releases, No 51 was then playing a key role in monitoring the 'no fly zone' over former Yugoslavia, working in conjunction with similarly equipped aircraft of allied air arms, such as USAF RC-135 *Rivet Joints* and US Navy EP-3E Aries IIs. A 33 per cent cut in unit strength would seriously reduce its operational capability.

Provision of a replacement was sought at record speed. Indeed, such was the urgency that some wag must have suggested that it might be a good idea to enlist the help of TV presenter, Anneka Rice. The series 'Challenge Anneka' then showing, centred on diverse and seemingly impossible tasks, usually of a charitable kind, being accomplished from scratch within a few days. Thus the replacement of the unfortunate Nimrod R1 XW666 became *Project Anneka*.

The story is an interesting one, and although many details remain secret or have to come from unofficial sources, it demonstrates how the RAF and the aerospace industry can work efficiently and rapidly together when the situation demands. Military programmes usually make the news only when they are late and over budget, so it may redress the balance to record that *Anneka* was completed just 23 months after go-ahead and went into service immediately.

The aircraft lost in the Moray Firth was no 'ordinary' maritime patroller, but one of the three very differently equipped Nimrod R1 electronic reconnaissance aircraft flown since 1974 by No 51 Squadron.

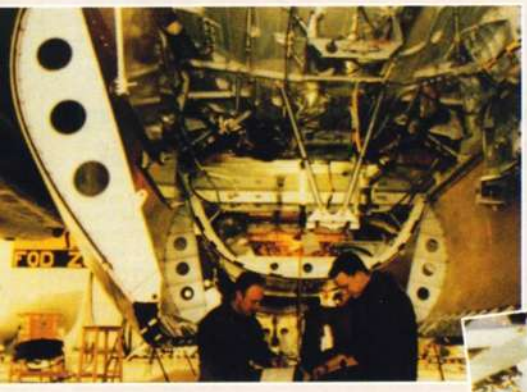
It was on 22 May 1995, a mere six days after the demise of XW666, that officials met at Wyton to discuss the question of a replacement, and on 1 June Gp Capt W W Robinson was appointed project manager. The following day, the name *Project Anneka* was officially adopted in deference to the intention of 'doing the impossible in a short time'. The team exceeded their brief in less than a fortnight, for by 13 June they had HM Treasury agreement for expenditure of up to £30 million – after that, everything would seem easy.

A replacement airframe was, relatively speaking, simple to obtain. The decline in Russian naval activity a few years earlier had allowed four maritime Nimrod MR2s to be placed in storage at Kinloss, and one of these, XV249, was selected to become an R1. The other three were later ferried, one at a time, to FR Aviation at Bournemouth inside an Antonov An-124 freighter – to become development aircraft for the Nimrod MRA4.

Further indicating the urgency involved, on 23 June British Aerospace was faxed an offer of a contract (SMC41a/0041) to modify XV249, while major servicing of the aircraft was begun three days later at Kinloss. With the offer provisionally accepted, talks began on integrating the work of BAe on the airframe with that of the Waddington-based Electronic Warfare & Avionic Detachment (EWAD), part of RAF Henlow's Signals Engineering Establishment. It would be EWAD's task to produce the special internal fittings for the new aircraft and install them in conjunction with the BAe personnel. Thereafter, EWAD would be solely responsible for fitting the numerous 'black boxes' into their appropriate mountings.

Its basic overhaul complete, XV249 left the Nimrod Major Servicing Unit hangar at

Kinloss on 6 October and after checking and test flying, departed by air on 23 October 1995 to return to its birthplace at Woodford, near Manchester, where it was immediately taken into the works. Having fitted two earlier sets of anti-submarine kit inside '249, BAe's first job was to remove the current



installations. This was completed by 2 February 1996.

Next came the complex task of rebuilding the aircraft's floor and installing equipment consoles for the crew. As an MR2, the Nimrod's interior is hardly palatial, but with 28 aboard (including the flight crew), the R1 may be presumed to have a 'cosy' cabin. Under the floor, in what was the weapons bay, mountings were made for the special equipment. The powered doors which once concealed mines and torpedoes were no longer required to open in flight, but were replaced with similar panels to simplify access for ground servicing.

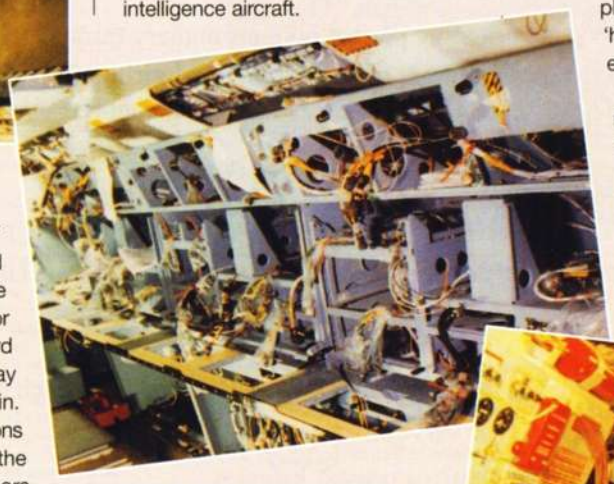
With work progressing on time, the RAF was sufficiently confident by July to book XV249 into British Airways' paint shop at Heathrow on 8 October. However, a change of plan caused that to be abandoned when, on 1 August, BAe was asked to undertake further airframe checks and operations such that the refurbished aircraft would be zero-timed when it began test flying. That complete, XV249 made another short hop on 19 December 1996, when it transferred to RAF Waddington.

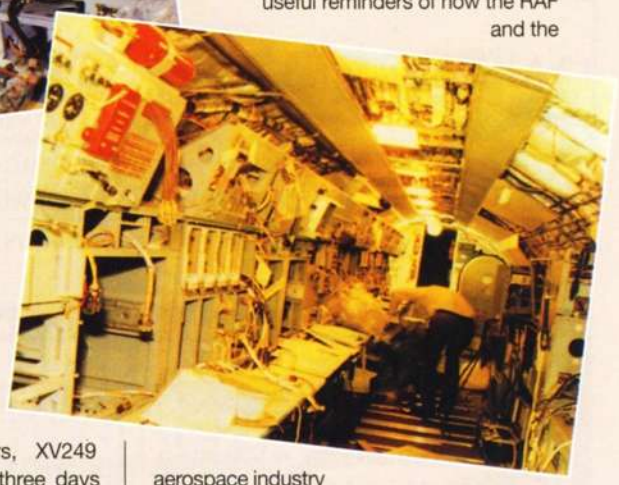
At that stage the Nimrod might have passed for an R1 at first glance, but was far from complete internally. Embodiment of Service Radio Installation Modification (SRIM) 6029 and other cockpit and radar modifications at Woodford had raised the aircraft to the stage where its mission equipment could be installed. The main package, SRIM 6113, codenamed *Starwindow,* was a new fit, then in the process of being installed as an upgrade in the two remaining Nimrod R1s (XW664 and XW665).

According to unofficial sources (see footnote), *Starwindow* was developed by E-Systems Melpar Division in Virginia, USA, to a specification issued in September 1991. It had originally been due for fleet installation between April 1994 and October 1995. At about the same time, its scope was extended by the addition of a 'special signals' intercept facility, giving a significant boost to the Nimrod R1's communications and electronic-intelligence subsystems.

Key aspects of *Starwindow* are believed to include two new, high-speed search receivers; a pooled network of 22 digital intercept receivers; a wideband, digital direction-finding system; an intercept capability against frequency-agile transmitters; and in-flight analysis equipment. The 'special signals' upgrade is said to involve a digital recording and playback suite; a multi-channel digital data demodulator; and an enhanced pulsed signal processing capability.

According to US sources, the influx of computerised equipment has not encouraged the RAF to follow the same path as the USAF and automate processes aboard its electronic intelligence aircraft.





Modification of Nimrod XV249 to R1 standard involved changes to the weapons bay (top) and the installation of equipment consoles in the cabin (above and right).

Seeing the traditional approach as best, it has maintained a large crew aboard the Nimrod R1 to tune its receivers and record and analyse collected signals.

Of more immediate matters, XV249 passed its acceptance checks three days after arriving at Waddington and plans were formulated for completing the outstanding tasks and rectifying minor faults identified during flight test. On 27 December, whilst much of industry was on an extended break, the RAF personnel of EWAD started work on the very special Nimrod. Installation of the *Starwindow* equipment began on 10 January, related work involving the various Temporary Radio Installation Modifications characterising the Nimrod R1. In parallel, a BAe working party was at Waddington between 8 January and 18 February to complete the airframe modifications.

Ground calibration of the aircraft's systems began on 31 March and on 2 April 1997 XV249 flew its first air-test as a full R1. Airborne calibration started on 11 April and was finished ten days later. With the issue on 28 April of a calibration report and table, *Project Anneka* was declared finished.

The new addition was immediately pressed into useful service and, indeed, so urgently was it required that it was several months before time could be spared for the 'new' Nimrod R1 to be properly painted. A plethora of primer-coloured panels on the 'hemp' original airframe clearly showed the extent of external modifications.

In all, *Anneka* had involved 56,583 man-hours of work by EWAD and involved the issue of 12,314 drawings and 40,142 prints from its drawing office and library. Although 23 months may seem a long time, in terms of military procurement it is but the blinking of an eye. Examples of such rapid and efficient working are useful reminders of how the RAF and the aerospace industry can accelerate to 'wartime' speed when urgent demands are made. It might make a rather good idea for a TV programme!

EDITOR'S NOTE

The content of this article is not based on official information. It has been compiled from details previously published in the Journal of Electronic Defense (Dec 1997), JAEMS – Signals Intelligence (Dec 1997) and made available to the public at RAF Waddington At Home Days (June 1997).

Nimrod R1 XV249 pictured in April last year after the completion of Project *Anneka*, clearly showing the extensive external modifications that were carried out. Peter R Foster

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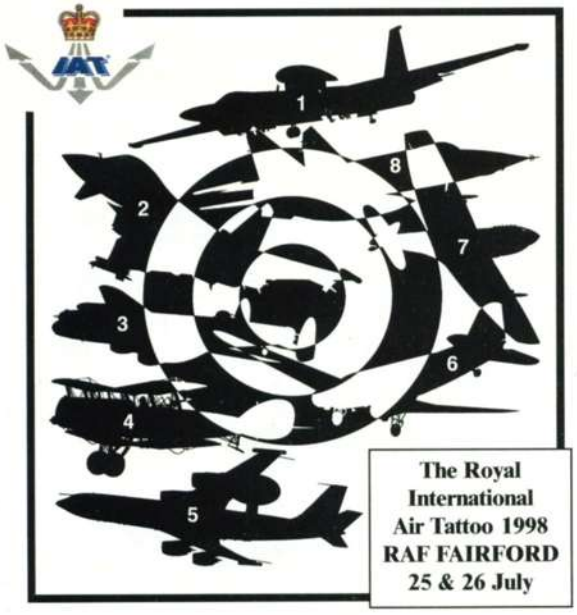

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Helicopter Support squadron

The increasing participation by the Royal Auxiliary Air Force's new Helicopter Support Squadron (HSS) in exercises in support of the RAF's Support Helicopter Force (SHF) during 1997 has highlighted the expanding role of reservists under the provisions of the new Reserve Forces Act.

Air Vice-Marshal B H Newton, the squadron's Honorary Air Commodore, is welcomed to the Bramley Training Area by Squadron Leader Damian Steel, Officer Commanding, HSS. Keith A Saunders

The ceremonies held at RAF Cranwell on 5 April 1997, marking the amalgamation of the RAF Volunteer Reserve and Royal Auxiliary Air Force, heralded a new dawn for the auxiliaries, that were the vision of Lord Trenchard – the founder of the RAF – in 1919. Indeed the exploits of the early Auxiliary squadrons that formed as light-bomber units during the early autumn of 1925 were to become Air Force legend. These included the first auxiliary unit, No 602 (City of Glasgow) Squadron, that formed at Renfrew on 15 September 1925 with DH9As and when eventually equipped with Spitfires, served with distinction alongside both regular and auxiliary fighter squadrons during the Battle of Britain. Some 14 of Fighter Command's 62 squadrons were Auxiliary Air Force units and responsible for the destruction of a third of the German aircraft shot down during the Battle.

The events at Cranwell, in the presence of HRH the Duke of York, featured a flypast by a pair of Pumas trailing both the RAF Ensign and the RAuxAF Pennant and heralded the eventual formation of further new RAuxAF units dedicated to support the air defence, strike attack, offensive air ops and air transport and air-to-air refuelling forces. Following hard on the heels of the HSS, the second unit to form will be based at RAF Cottesmore and personnel will support both Harriers and Jaguars.

Recruitment and selection of personnel resulted in the HSS receiving over 1,800 applications to staff the 163 vacant positions.

Focusing on the formative months of the HSS, the first of the new 'composite' role-support squadrons was tasked with providing a range of ground support activities for the SHF. Events began when the unit was formed during October 1996, with a nucleus of regular personnel charged with recruitment of new personnel together with the acquisition of accommodation and equipment.

Recruitment and selection of personnel was immediately initiated with the HSS receiving over 1,800 applications to staff the 163 vacant positions. Despite three-quarters of the squadron personnel having previous military service, other members of the unit have no military background and are drawn from a wide selection of civilian occupations. These range from a train driver, a nursing officer, a fork lift driver and a production manager for a medical company. Current planning calls for the nucleus of regular personnel currently posted to the HSS, to be replaced by RAuxAF personnel as the unit becomes fully established.

Under the command of Squadron Leader Damian Steel, the HSS was established at RAF Benson, a central location with easy access for reservists, and a station that presently hosts the Puma HC1s of No 33 Squadron – and from the beginning of the new millennium, the first Merlin HC3s of No 28 Squadron, when it reforms at Benson. Thus the HSS will be ideally located to support both the Benson and Odiham elements of the HSF.

A series of recruit courses held at the Bramley Training Area, close to Basingstoke, provided each course with basic core skills, including weapons training and medical and general service knowledge. Training in the woodlands at Bramley, which features such diverse training aides as elderly railway carriages and a variety of helicopter hulks, provided a realistic scenario. Recruits sampled the hardware of the SHF in the form

Main picture: The Chinook is currently the RAF's only twin-engined, medium lift helicopter, and can carry up to 45 fully equipped troops. Darron Hall

Support for SHF operations will be provided by a combination of Chinook HC2s (left) and Puma HC1s (above) from the HSS. Kevin Wills/Darron Hall

of familiarisation sorties, provided by a No 33 Squadron Puma HC1, flying from clearings in the woodlands.

When the SHF ran Exercise *Red Beaufighter* at RAF Colerne during a five-day period in April 1997, as a prelude to a major review by NATO of UK helicopter operational capability to be conducted in 1998, the HSS provided 20 personnel to support the Command Post Exercise in a variety of roles. These included providing manning for the General Engineering Flight, the Mobile Catering Support Unit and the Intelligence Cell. Recent events have also featured transatlantic exchange posting between Air National Guard (ANG) personnel of the C-5A Galaxy equipped 105th Airlift Wing at Stewart ANG Base, New York and the HSS's Flight Lieutenant Jerry Saddington.

Currently the HSS will, when required, support SHF operations that will essentially involve the Westland/Aerospatiale Puma HC1 and Boeing Vertol Chinook HC2, with the new Merlin HC3 waiting in the wings and due to enter service at the turn of the century. Examples of the ageing Westland Wessex will remain in service until 2002, although the type is no longer declared to NATO.

No longer declared to NATO, the Wessex will soldier on until 2002. Kevin Wills

Turning to the Puma HC1, the helicopter was developed from the original French SA 300 in 1965. Apart from the first Puma, XW241 that was French built, subsequent production aircraft for the RAF were built by Westland at the Hayes facility, with the first British production Puma HC1 XW198, flying for the first time on 25 November 1970. A twin-engined, single-rotor tactical helicopter capable of carrying up to 16 fully-equipped troops, the helicopter provides both a transport and medium-lift capability.

A total of 40 Pumas were built for the RAF and the helicopter has operated in a wide range of roles including CASEVAC, troop carrier and as a helicopter gunship. To support allied operations during the Gulf War, a composite Puma squadron, comprising elements of No 33 Squadron at Odiham and No 230 Squadron at Gutersloh, were air-freighted from Brize Norton in Lockheed C-5s and accompanied ground forces throughout the campaign.

Clearly the long-term future of the HSS will be closely linked to the new Merlin HC3.

The Chinook, with a crew of four, is currently the RAF's only twin-engined, twin-rotor medium-lift helicopter. Providing airlift capability for the Army, the Chinook can carry up to 45 fully equipped troops or up to ten tonnes of equipment, either internally or underslung and is equipped with a rear loading ramp and triple hooks for the carriage of underslung loads. Survivors of the original batch of 41 HC1 helicopters were upgraded to HC1B standard, with 32 examples of the HC1B later modified to HC2, with an additional three new build HC2s ordered during 1993. A $365 million order for a further 14 RAF Chinook HC2/3s was placed during March 1995 and included nine HC3s which will be operated in the Special Forces role.

The Chinook featured in the Falklands War, where despite the loss of three aircraft aboard the *Atlantic Conveyor*, the surviving Chinook of No 18 Squadron completed 109 flying hours and carried some 2,150 troops and moved more than 550 tonnes of equipment and stores. RAF Chinooks also flew operations in the Gulf War when personnel from No 7 Squadron at Odiham and No 18 Squadron at Gutersloh operated 15 aircraft under the guise of Chinook Squadron Middle East.

Clearly the long-term future of the HSS will be closely linked to the new Merlin HC3. The product of EH Industries Limited, and the subject of a £500 million order for 22 aircraft for the RAF announced on 9 March 1995, the new helicopter will greatly enhance the RAF's tactical transport helicopter capability. Equipped with a 'glass cockpit', FLIR and the option of in-flight refuelling, the new helicopter will lift 30 combat equipped troops and their equipment when operating in the tactical support role. The rear-loading ramp provides access for troops, while the optional refuelling probe, when fitted, will be utilised when tanking in conjunction with the RAF's new C-130Js.

During September 1997, the HSS deployed by sea to RAF Laarbruch, in support of Exercise *Rhino Replen*. The joint RAF and Army exercise featured the SHF with HSS personnel supporting the Pumas of No 33 Squadron. The field exercise covering the area between Laarbruch and the Lippe Valley tested the Total Force Concept of the remodelled reserve when deployed as an integral component of the service.

With the strength of the regular RAF due to downsize by April 1999, and an identified war-fighting required strength of nearly double the reduced figure, the new auxiliaries clearly have a not inconsiderable manpower gap to fill in the event of a major 21st century conflict.

Recent trials have featured a small number of reservist aircrew flying both the Hercules and Wessex, culminating in reserve Hercules aircrew, joining Nos 24 and 30 Squadron at RAF Lyneham and the Wessex crews moving on to operate the Puma.

In addition current trials also involve a year long evaluation that allows reservist aircrews manning Tornado F3 air defence interceptors. These reservists have a full flying commitment, while maintaining combat ready status for a two to three year period after leaving the service. Plans call for aircrew to either train on a part-time basis in peacetime to provide augmentation to the front line squadrons in either crisis or war, or to provide a cadre of aircrews able to replace a small number of regular appointments in peace and war on the front line, or in support formations.

However, the role of the Helicopter Support Squadron will, without doubt, feature a flexibility, that will provide support for the Support Helicopter Force, while working from tactical field sites or the helicopter squadron's home bases, when tasked world-wide on Peace Support Operations with NATO, or with the recently formed British Joint Rapid Deployment Force. In addition, the HSS will undoubtedly play an important role in peacekeeping, humanitarian and disaster relief operations, which will graphically illustrate the new and important roles performed by the Volunteer Reserves.

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Rob Linge served close to the front line in the Gulf war. A former RAF chef, he lost his arm when a field cooker exploded. The Fund stepped in helping Rob with accommodation and to adjust to his new civilian life.

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Shattered Lives... *on the* Mend

Day after day the Royal Air Force Benevolent Fund helps those who are suffering from difficulties that are no fault of their own, problems such as sickness, disability, accident, infirmity and poverty. The beneficiaries include the many thousands disabled in the World Wars and those from associated air forces who fought along side.

We also forget sometimes that our RAF servicemen and women are still on active and dangerous service in Bosnia, Rwanda, The Gulf, Turkey and Northern Ireland, to name but a few operational areas. And what of Gulf Syndrome and its suggested legacy of disfigured children? The family of the RAF is still very much in need of our support.

The Royal Air Force Benevolent Fund is able to help care for those who are still serving and those who have in the past served with the Royal Air Force, their spouses, widows or dependant children.

The bill for such care last year reached a staggering £14,000,000 (no admin costs included). This amount being more than the charity received; yet still the RAF Benevolent Fund will put no ceiling on the assistance given; if there is a need, the Fund will do all it can to meet it.

Should you, as a member of the RAF family, be in need of the Fund's help, then we would encourage you to get in touch. Equally, if you know someone else who is, please ask him or her to do the same.

By A 'Hare's' Breadth

Former pilot Ian Christie-Miller has recalled the accident 35 years ago that saw him careering across a disused airfield through telegraph poles and wrapping him around a water tank with both legs broken - but feeling lucky to be alive.

The young trainee pilot, following a fire warning at 39,000 feet attempted to land his Gnat without an engine. He was instructed to land at RAF Hawarden. Unfortunately, the runway that he spotted under his wing was not Hawarden but the disused Sealand airfield, unmarked on his map and covered with a variety of obstacles.

Reports of the time said: "He flew under the power cables and touched down on the runway only one hundred yards from the threshold. With normal luck, he should at this stage have been able to congratulate himself and start to breathe again."

"But the short runway, strong crosswind, and the obstructions weren't going to allow this. Braking frantically, he couldn't stay on the runway, and as he veered off, he struck a hare, a wire mesh fence, a flood light pole and a disused static water tank. He was lifted from the wreck by the RAF Fire Service at Sealand, his legs broken below the knee and suffering concussion."

Invalided out of the RAF some years later as a result of his long term injuries, Ian was forced to turn to the Royal Air Force Benevolent Fund for assistance to help him and his young family with accommodation.

Twenty years on and Ian has two grown up children the youngest of whom, Rachel, has just married. It was this happy event that prompted Ian to write to the Fund. "It occurs to me that those at the Fund may not know how much their work is appreciated and how beneficial the effects are. It is only too easy for beneficiaries such as myself to disappear over your horizon, I have not neglected to tell my children of the debt we owe to the Fund and in due course I shall repeat it to the grandchildren!

Thank you."

The RAF's Charity

The Benevolent Fund? What does it do?
One day perhaps it could even help you.
You pay such a little, it means a great deal,
Please do your best when they make an appeal.

When a colleague's in trouble, perhaps very ill,
Or through circumstances, can't pay a bill.
They turn to the Fund to help them to live,
The help then depends on what you can give.

The Fund gives them help, when they're in dire straits,
The least they can do for one of your mates.
How often you think it could not be me,
To be really honest, I'm as fit as a flea.

Not all are so lucky, no fault of their own,
Sometimes a loved one is left all alone.
It may be a husband, it may be a wife,
But twenty-four hours has changed their whole life.

From now on a struggle, a battle to live,
So please be grateful you are able to give.
The Fund has to deal with problems galore,
They solve all today's and along come some more.

Can you imagine, not able to talk?
Losing one's sight or unable to walk?
Sadly, it's something that happens quite often,
So the money you give, the blow it can soften.

Our Fund is a good one, of that I am sure,
It gives of it's best, and wish it were more.
Helping your friends, when they need it the most,
Please send in your gift by the very next post.

Benevolent Fund Supporter, Stanley Adcock

New found freedom for Leslie.

Leslie Johnston suffers from spondylitis, a crumbling spine, and severe arthritis. But life has taken on new meaning with the freedom gained from his new powered scooter provided by the RAF Benevolent Fund. Leslie was an engine fitter with the RAF and served throughout the War.

For 11 year old Brian Alldis a sports wheelchair seemed a far off dream.

The Benevolent Fund however, saw every reason to buy one for the ex-Flt Sgt's son. Not only is Brian now able to join his friends on the sports field, but he can get himself to school without his mother's assistance.

One in a Million

Ex-RAF Mountain Rescue man Ivor Warn (68) has taken up a challenge to row one million meters on a rowing machine during his recuperation from by-pass surgery to raise money for the RAF Benevolent Fund. Ivor's effort and determination guarantees the future for those who might need the Fund's help.

At 21 Cpl Mark Bosanquet-Bryant a RAF Policeman had everything to live for.

But 6 weeks after getting married he dived into a swimming pool breaking his neck. Left with only minute movements of the head, Mark has fought back and, with the help of a computer purchased by the RAF Benevolent Fund, Mark is now a graphic designer. His first project - the livery for Global Challenge boat "Time & Tide".

Little Amy is the daughter of ex-SAC Richard Baxter.

She is energetic and mischievous and has fought against tremendous odds. She suffers from a rare illness and now, at age five, needed the benefit of a special computer to help her with her learning. The RAF Benevolent Fund were able to help with the cost and Amy is now beginning to recognise colours, shapes and numbers.

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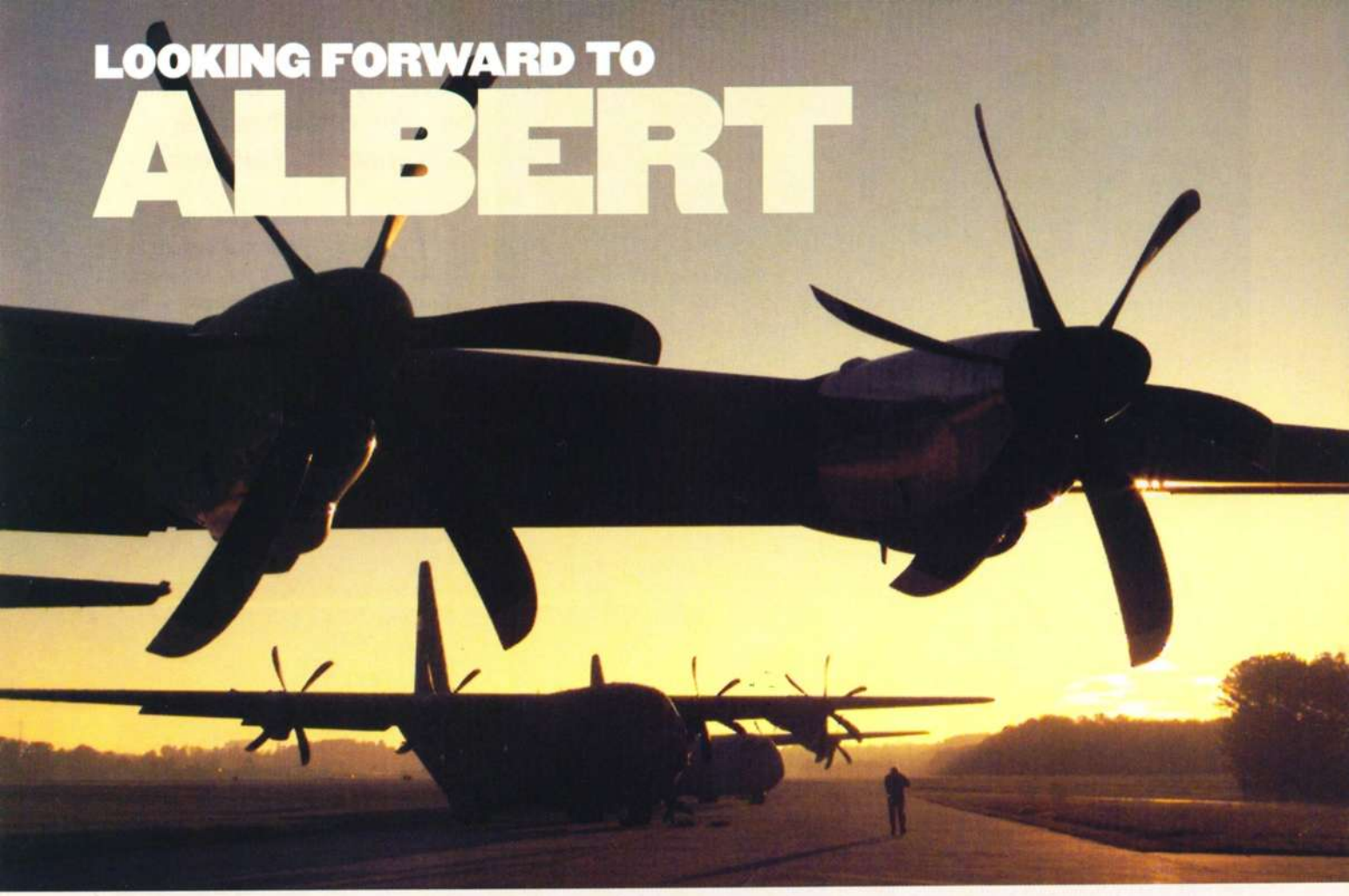


As the C-130J enters service, **Andrew March** reports from Marietta, Georgia – the home of the Hercules – on the work that has gone into preparing for the arrival of the RAF's new tactical transport aircraft, which promises to be both highly reliable and far more maintainable than the model it replaces.

A new aircraft will join the RAF inventory during 1998 in the familiar shape of the Lockheed Martin C-130J Hercules. To the casual observer, the latest model looks externally similar to the thousands of Hercules already in use around the world today; however, looks can be deceiving and the new C-130J is a very different aircraft from the prototype Hercules which first flew in 1954.

By the early 1990s the RAF's existing fleet of C-130K Hercules had accumulated over one million tactical and strategic flying hours, primarily in support of the British Army. The aircraft were showing their age with corrosion and fatigue related problems leading to steadily escalating maintenance costs and decreasing reliability. Hence, in November 1993 the requirement to replace approximately half of the RAF's existing fleet of Hercules transport aircraft was issued and, following a costed evaluation of the tender responses, the decision was taken to order 25 C-130Js; 15 of the stretched C-130J-30, and ten of the standard length C-130J, to be known in RAF service as the C4 and C5 respectively.

Chief Tech Paul Bradshaw of the AMDS Project Team checks the fit of a Dowty six-blade composite propeller on its transportation dolly in the C-130J's cargo compartment.

The contract not only included the aircraft but covered a new-build training facility and equipment (both for aircrew and maintainers) test and support equipment, technical publications and full support of the aircraft, except for on-aircraft maintenance, for an interim period. It is significant that the acquisition is an 'off-the-shelf' purchase with no further development of the aircraft being funded by the Ministry of Defence.

The steadily increasing cost of owning and operating military aircraft over their service lives of typically 30 years or more, has lead the MoD to adopt a procurement policy for all new equipment which requires that support factors are given equal consideration with operational performance, cost and timescales. This highly structured and all-encompassing approach to support is known as Integrated Logistic Support or ILS. Soon after the C-130J contract was signed, a full-time ILS team of five service personnel was established at the Ministry of Defence Procurement Executive at Abbey Wood, Bristol to work alongside the Project Manager as part of his staff.

Led by an RAF Wing Commander aero-systems engineer, the ILS Team has overall responsibility for support arrangements for the C-130J and has from its early days drawn on a wide range of specialist staff to provide advice and assistance. Foremost amongst these other organisations is Aerospace Maintenance Development and Support which is part of the Logistic Support Services Defence Agency.

With the post-war jet age and technically more complex aircraft came the realisation in the RAF that a structured approach to maintenance was essential. This lead in 1950 to the formation of the Central Servicing Development Establishment (CSDE). From the early days of Aircraft Servicing Parties placed in British industry, CSDE was intimately involved with all aspects of introducing new aircraft into service. After more than 35 years

Above: The first air-to-air refeulling of an RAF C-130J by an RAF VC10 K4 near Pensacola, Florida.
All photographs John Rossino, Lockheed Martin

at RAF Swanton Morley, CSDE became part of Logistic Support Services and moved to HQ Logistics Command at RAF Wyton in 1995.

The change of title to AMDS has not affected the role of the small teams of high-calibre RAF technicians who work within industry from the very outset of a project providing advice to industry on RAF maintenance practices and acting as the on-site 'eyes and ears' for the Project Office's ILS Team. Each AMDS field Team is backed up at Wyton by highly knowledgeable specialists, both servicemen and civil servants, who are able to carry out detailed investigations and ensure that best practice from other projects and aircraft types is widely communicated.

The AMDS Project Team at Marietta comprises an RAF Squadron Leader engineer and six Chief Technicians covering the aircraft maintenance trade groups, plus support equipment and provisioning. The Team deployed to the United States in April 1995 and has since worked alongside the MoD's Resident Project Office staff within the C-130J production plant.

To ensure a methodical and thorough approach to support, Lockheed Martin was contracted to apply a process called Logistic Support Analysis (LSA) to the C-130J project. LSA breaks down into discrete tasks the huge job of considering how the aircraft will be best supported and maintained. Some of these tasks were not applicable in the case of the C-130J whose design was largely complete; instead the suite of tasks has been tailored to those which would help to determine the optimum support system and logistics requirements for the lifetime of the aircraft. The results of this analysis are held on a relational database called the Logistic Support Analysis Record.

Traditionally within industry the various support departments such as technical publications, reliability, provisioning, packaging and transportation have worked independently of each other to different agendas and often with conflicting goals. The net result was increased cost to the MoD as a large number of changes were necessary after the aircraft had been introduced into service. ILS seeks to bring these groups together and by holding all information on a common data base, duplication of effort is avoided and the AMDS Project Team has visibility of the work being carried out by the Company.

The use of LSA has helped to ensure that the full range of spares has been identified, procured and delivered to the UK ahead of the first aircraft's arrival. Equally importantly it has ensured that should an item of C-130J equipment fail then the technical publications and test equipment to trouble-shoot the problem have been identified and are available at RAF Lyneham.

The Ministry of Defence's C-130J contract puts stringent maintainability and reliability targets on Lockheed Martin and to meet these the Company has designed into the C-130J a state-of-the-art self diagnosis system. The Integrated Diagnostic System (IDS) has been made possible because the C-130J is truly a software-controlled aircraft. Whilst not having fly-by-wire flying controls there are very few systems on the aircraft which are not controlled by a computer. Communications between the main computers and the many other software-driven black boxes is via a databus and it is by tapping into this information highway that the technician can easily and rapidly diagnose problems with a high degree of confidence, down to an individual faulty component.

The C-130J is truly software-controlled – whilst it does not have fly-by-wire controls, there are very few systems on the aircraft that are not controlled by computer.

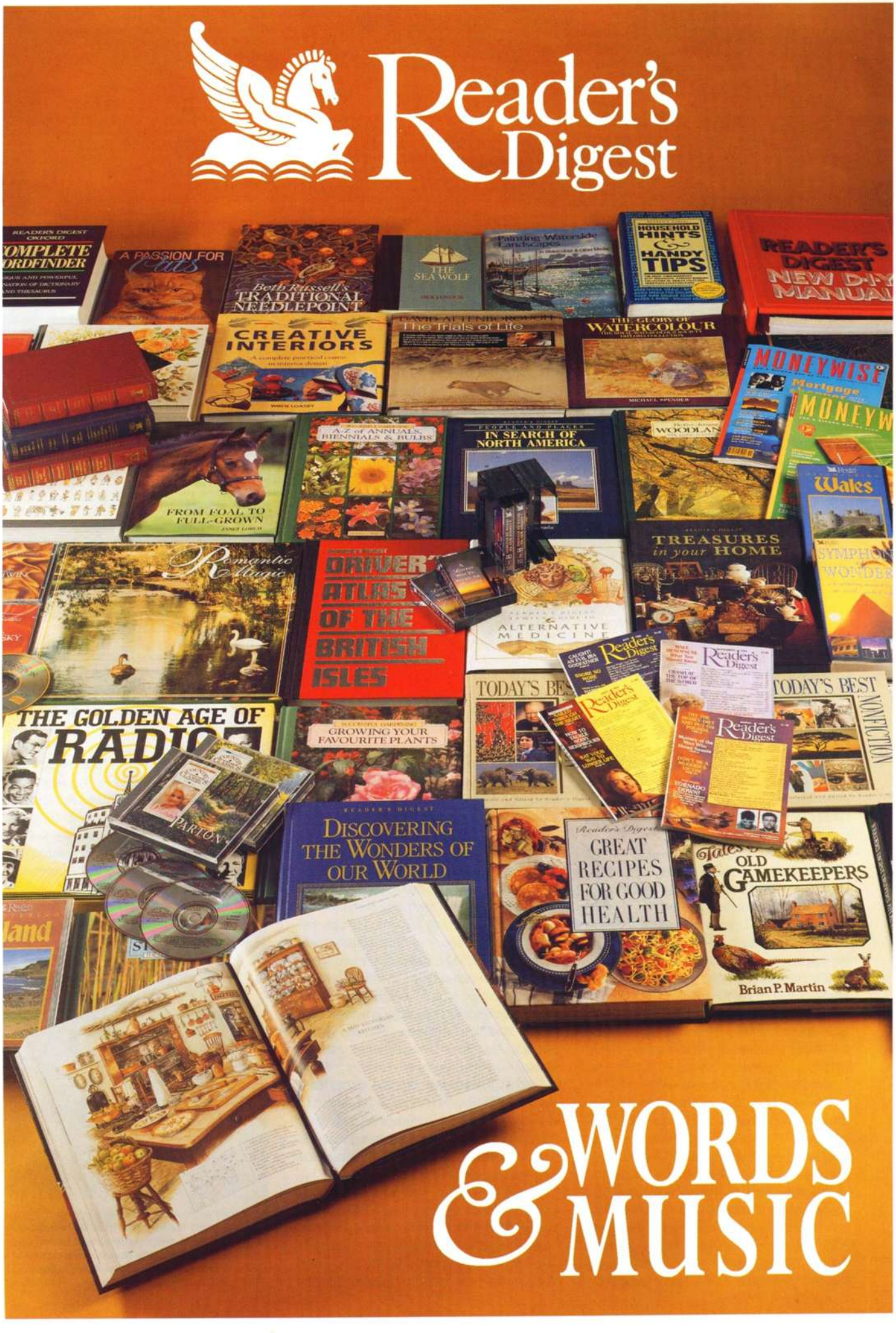
The IDS goes well beyond built-in test since aircraft systems are continuously monitored in flight and, where a fault occurs, this is electronically logged and is available to the maintenance crew post-flight. The suite of nearly 200 technical manuals is hosted on a single CD-ROM which can be read at the aircraft. Maintenance paperwork can be raised, completed and cleared, again electronically, at the aircraft. The AMDS Team has been closely involved with all stages of development of this diagnostic system to ensure that its high degree of functionality is also matched with RAF maintenance practices and ease of use.

The AMDS Team has completed many tasks from vetting of Technical Publications, to compatibility tests of support equipment, to ensuring that those painful and expensive lessons learnt in maintaining the existing C-130K fleet are fed into the maintenance

With engines running, the second RAF C-130J undergoes a heat soak in the McKinley Climatic Laboratory at Eglin AFB, Florida.

philosophy for the new aircraft. Many other organisations have been consulted by the Project Office's ILS Team during the last three years; however, none has been so intimately involved as the on-site AMDS Team. At all stages of development and throughout the comprehensive flight test programme, which has now lasted for close to two years, the AMDS PT has been both actively *looking after* the future interests of the RAF Lyneham technicians who will have to keep the C-130J fleet in the air and *looking forward* to the introduction of the only worthy successor to the Hercules – another Hercules.

The RAF Team and Lockheed Martin engineers have worked closely together to develop the C-130J's fault diagnostic procedures; here Chief Tech Pete Looper is involved in validation of a maintenance procedure which uses the RAF's CMS33A test set.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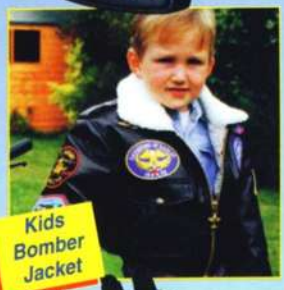
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LIFE AS A JENGO

Flt Lt Kev Storer reflects on his first year as a Junior Engineering Officer with No 12 Squadron at RAF Lossiemouth.

Above & below: Tornado GR1Bs have equipped No 12 Squadron at Lossiemouth since 1993, operating alongside No 617 Squadron in the maritime strike role. John Dibbs/Kev Storer

Four Tornado GR1Bs leave their Hardened Aircraft Shelters (HASs) at an RAF airfield for another routine mission. This is the culmination of several hours of work by the ground crew and a similar time spent planning the flight by the two-man crew of each of the four aircraft. The considerable effort by the groundcrew to get these aircraft in the air has involved a team of three key 'managers' who have worked closely together: the Senior Engineering Officer (SEngO), Junior Engineering Officer (JEngO) and perhaps most importantly, the Warrant Officer (WO). These three people must ensure that the daily flying programme is met and the engineering standards and practices are adhered to, as well as balancing the day-to-day tasks of 140 squadron engineering personnel.

The work of preparing the Tornado aircraft will have started some hours before, when the night shift will have made sure that no further maintenance was required on any of the four aircraft programmed for the 10.00 am sorties. It is then left to the day shift to ensure the aircraft are ready for flight. Typically this means that they will be at work for some two hours before the programmed take off time so that they can carry out the prescribed 'before flight servicing', necessary before the aircraft can be cleared to fly. Then, after assisting the aircrew to get settled into the cockpit and the aircraft start-up procedures have been completed, they marshall the aircraft safely out of the HAS. Whenever there are aircraft airborne, one of the four Engineering Officers (EngOs) will be present, to be sure that if any of the aircraft return with a problem, appropriate actions are carried out.

As a Squadron Leader, the SEngO is an experienced engineer who is responsible for the overall engineering work on the squadron. In particular he is concerned with the higher level engineering policy, rather than the day-to-day task of meeting the flying programme. The routine daily tasks are devolved to the squadron's JEngO. In the case of Tornado squadrons, there are two JEngOs, each in charge of a shift of some 70 personnel. The majority of RAF Aerosystems Engineering Officers eagerly await the chance to hold one of the limited number of JEngO posts on a frontline squadron, and only get such an opportunity once in their

No 12 Squadron Tornado GR1Bs, equipped with Sea Eagle air-to-surface missiles. Peter R March

career. Understandably, JEngO tours have a reputation for being very enjoyable and, despite having to work long hours and very hard, they do give the best opportunities for travel, with detachments and exercises all around the world.

The main role of the JEngO is to act as a liaison between the aircrew and the groundcrew to ensure that the aircrew are aware of the constraints of the aircraft when planning the flying programme, and that the groundcrew work towards preparing aircraft for the days activities. In order to do this, the JEngO must have an understanding of the aircraft, its systems, and their operation. This is achieved by attending the aircraft managers' course and by discussions with the specialist aircraft tradesmen on the squadron. Knowledge to the same depth as the specialist tradesman will never be attained but what is required is more of an overview in order that questions can be fielded and, after consultation, appropriate answers given or solutions found. As important as engineering decision making is their dual role of flight commander. This involves the assessment and welfare of personnel as well as processing the endless mountain of paper work that is generated by any large organisation. Good managerial skills are very much needed and always utilised.

The main role of the JEngO is to act as a liaison between the aircrew and the groundcrew to ensure that the aircrew are aware of the constraints of the aircraft.

Having achieved their dream posting it is with great trepidation and a measure of excitement that most new JEngOs arrive on their squadron. Depending at which stage of an officer's career this posting occurs, the individual will have undertaken either six months or a year of professional engineer training at RAF College Cranwell in the Department of Ground Specialist Training. It is at this point that a nervous anticipation of the job ahead really sets in. As with most RAF postings the first person you seek out is the individual whom you are replacing on the squadron, closely followed by your immediate boss. Then follows the usual week of handover, consisting of a bewildering tour of the squadron, the station and meeting all the personnel you will be working with; as well as explanations of your role within the squadron. You are required to assimilate the engineering aspects of the position as well as details of the personalities within the squadron and all the tasks that you are required to undertake daily. This is by far the most confusing time for the new JEngO; there appears to be a myriad of terms, abbreviations and rules that have to be learnt and understood. The task ahead is, not surprisingly, now looking extremely daunting.

Despite any previous experience, the new JEngO will be in a new environment where they are very much like a pupil who has to earn the respect and trust of those around. Although academically qualified for the job the JEngO is very much lacking experience. This can only be overcome by listening and talking to the squadron Warrant Officer, a key individual who is very much your mentor. The WO is extremely experienced and has had many years service in the RAF and has seen many engineering officers come and go. They are very adept at teaching JEngOs their trade and will not allow the 'new boy' to make any decisions that will affect the safety of the aircraft or any of the squadron personnel. The WO is held in such esteem that he will usually be the first port of call for senior officers with detailed questions about the aircraft. At this point the new JEngO is usually keen to impress and eager to be allowed to make executive decisions. This will only be allowed once the WO and SEngO are happy that the JEngO knows enough about the aircraft and the way in which the squadron runs to be able to lead a detachment as the sole EngO. Time, patience and perseverance will be needed.

The engineering authority known as 'Reds and Greens' is the point when the JEngO is allowed to make engineering decisions affecting the aircraft and sign for them in the aircraft maintenance documents. The term 'Reds and Greens' comes from the colour of the pages of the aircraft engineering documents. 'Reds' indicate limitations (Lims) on the operational capability of the aircraft and therefore are relevant to the aircrew, whereas 'greens' or acceptable deferred

Above top: The JEngO must be aware of any engineering problems as they occur and ensure that the necessary work is progressing to rectify them. Above: Groundcrew loading a dummy weapon beneath a Tornado's fuselage. Andrew March

defects (ADFs) are used to highlight something within the aircraft that does not affect its operational capability but requires recording so that it can be rectified at a later date. In both cases the prime concern of the engineers is flight safety and whether a Lim or ADF is appropriate. Use of the aircraft maintenance schedules will indicate whether or not a Lims and ADFs can be used and it is then up to the EngO to decide the wording of the entry and a suitable review date. This system will only be employed when there is no flight safety risk, the aircraft is required for the flying programme and there is no alternative that can produce an acceptable solution to the engineering problem.

Throughout the day the aircraft will return from their sorties and some will inevitably require rectification of faults that have become apparent during the flight or have been picked up by the groundcrew carrying out the subsequent servicing. Having returned the aircraft to the HAS, the aircrew hand the aircraft back to the groundcrew, sign the aircraft documentation and carry out a debrief concerning the engineering and

serviceability aspects of their aircraft on the sortie. Although not essential, the JEngO will try to be present for these debriefs; the engineering content will be left to the relevant trade specialist to debrief.

The JEngO is required to keep abreast of all the engineering problems occurring throughout the day and must ensure work is progressing towards rectifying them, this is carried out with the assistance of the squadron Rectification Controller. Usually a senior and experienced chief technician, he can be relied upon to ensure that rectification work is undertaken as well as routine scheduled maintenance activities on the aircraft. He is also responsible for the upkeep of the aircraft maintenance documentation and for ensuring that the appropriate EngO signs off the relevant ADF or Lim.

A benefit of being on an operational flying squadron is that detachments away from base are an inevitable part of life for the JEngO. For a Tornado squadron these typically range from the Middle East to Canada and Northern Europe, Turkey to the USA and the Far East. This will be in addition to exercises, exchanges or international co-operative training at other bases in Britain or other NATO countries. This can result in as much as six months a year away from home. In the main these detachments will involve taking equipment and groundcrew to maintain between two and eight aircraft. If the SEngO is not part of the detachment the engineering aspects (of the detachment) are

During maintenance, the Tornado's two RB199 engines are made accessible by lowering them onto a special trolley. Jeremy Flack/API

entirely the responsibility of the JEngO. This will include making sure that all personnel and equipment are transported to the detachment and that adequate accommodation is secured. Once away on detachment the same engineering practices and standards that are used back home are employed. This is especially critical when maintaining quality assurance issues and flight safety standards.

Detachments and exercises also have many pitfalls for the new and inexperienced JEngO. If the Squadron is in foreign country there might be local rules which prevent normal practises from being employed. These rules have to be obeyed unless local authority to break them can be obtained. Getting over-involved with the exercise scenario or host base can be another problem for the inexperienced JEngO. It is in this area, that the Squadron WO will be invaluable, as he will inevitably have carried out many detachments and will be able to steer the JEngO out of difficulties. It is in giving guidance that the WO is especially valuable, and with his length of service there will not be many things that he has not encountered before.

It is important that the JEngO understands what is going on around the squadron and in order to do this he/she is required to spend as much time as possible away from his desk, acting as a liaison with the groundcrew and aircrew. This role will not only increase the JEngO's knowledge but will allow him to be part of the running of the Squadron. Gaining first-hand experience can be the most important aspect of solving a problem. It allows for a greater depth of understanding and subsequent supply of a timely and appropriate solution. This liaison not only takes place during work time but can often spill over into social events, particularly when on detachments. This off-duty time can sometimes yield the best results in terms of solving problems and getting work completed.

Depending where you are in the world you and the serviceability of the aircraft the work of a JEngO can be extremely rewarding. The JEngO tour is cited by many as one of the most enjoyable jobs for a junior officer within the Aerosystems Engineer branch of the Royal Air Force as it combines managerial skills with engineering knowledge and has a definite end result for your work.

UPGRADING THE RAF's Jaguar

Jon Lake introduces the upgraded Jaguar GR3.

There was a time, in the early 1970s, when the Jaguar was the latest and most glamorous aircraft in the RAF inventory. Before it was eclipsed by the Tornado (and later by the Harrier GR7) the Jaguar was the inevitable subject of recruiting adverts and posters, and graced the covers of PR booklets and leaflets produced at the time. But the Jaguar was soon supplanted by more modern and more glamorous types when the RAF wanted to present its public face. By the late 1980s, the Jaguar was often seen as an aircraft that had 'had its time' and was 'on its way out'. There was even regular speculation that the Jaguar might be retired early, as an economy measure. But remarkably, the end of the Cold War, and especially Operation *Granby*, demonstrated the Jaguar's inherent usefulness, due to its ability to be rapidly deployed 'out of area' and due to its reliability, ruggedness and maintainability, even when operating away from base.

When the RAF urgently required more laser designator platforms for use over Bosnia, circumstances combined to make the Jaguar the only choice and a crash programme of modifications was designed and incorporated on eleven aircraft. The success of this original modification prompted a fleet-wide package of similar modifications, transforming the Jaguar's capabilities, and providing a case study for how far-reaching modifications can be quickly, efficiently and economically incorporated onto frontline fast jets.

With the many new capabilities now being integrated onto the ageing Jaguar, the aircraft perhaps deserves a second chance to enjoy the limelight. It is arguably the most capable and useful tactical aircraft the RAF has with which to meet the rapid-deployment 'get up and go' needs of the RAF in the post-Cold War world.

Radical upgrading of the Jaguar began during Operation *Granby*, when service and industry teams designed and incorporated a host of modifications which dramatically improved the aircraft's capability. These included the provision of overwing AIM-9 Sidewinders, and some radar 'stealth' (RCS reduction) measures including the use of Radar Absorbent Material (RAM) tiles in the intakes and Surface Wave Absorbent Material (SWAM) on leading edges. *Granby* aircraft also received new or revised IFF, communications and EW equipment, and the clearance of a range of new weapons. These modifications were generally carried out by 'abusing' the Special Trials Fit procedure, and though the procedure provided the modifications quickly, it was felt that had more time (or warning) been available, a properly planned rolling upgrade programme would have allowed more time for training, and for the development of tactics which could have

Above:
Cockpit of Jaguar 96. BAe

Main picture: A No 6 Sqn Jaguar (nearest aircraft) fitted with a TIALD pod, in formation with Jaguars from Nos 54 and 41 Sqns, armed with a Pave il laser-guided bomb and a 1,000lb conventional bomb respectively. Rick Brewell

Above: Instrumented Jaguar XX108 is used for aerodynamic clearance of self designation fit.

more fully exploited the new capabilities.

When the RAF seemed to have been sidelined in operations over the former Yugoslavia, because of the lack of autonomous LGB designators, an Urgent Operational Requirement (UOR) was issued to provide additional airborne laser designation capability. With Tornado already being equipped with TIALD under a programme which could not easily be rushed, and with the Harrier GR7 force already in the midst of integrating a complex package of equipment, the Jaguar was selected as an interim TIALD platform almost by default. A DERA (Defence Evaluation and Research Agency) Jaguar had already been integrated with TIALD as part of a research programme aimed at investigating the feasibility of using a laser designator in a single-seat environment, and this integration was effectively put into production for the planned installation in ten single-seat Jaguar GR1As and two T2As.

The contract for the integration was placed with DERA, which had more relevant recent Jaguar knowledge and experience than the manufacturer. DERA at Boscombe Down produced and fitted a Trial Installation in the first of what became known as the Jaguar GR1Bs, and a single Proof Installation aircraft. The UOR aircraft operated under a deviation to the GR1A release to service, and theoretically should not have received a new designation suffix, though they were soon widely known as GR1Bs. A second Proof Installation aircraft was converted by an RAF

Jaguar 96 prototype XX738 with TIALD in co-operative designation fit.

Warrington, best known as the manufacturers of computer games, were commissioned to produce a PC-based TIALD simulator, linked to a real Jaguar stick-top and hand controller, which gave an accurate representation of what the pilot would see when operating TIALD. Remarkably cheap and yet a very useful training tool, the TIALD simulator was delivered in large numbers with admirable speed, giving sufficient workstations for all the squadrons.

The success of the Jaguar GR1B gave the type a new lease of life, while delays to Eurofighter's service entry date made it necessary that the aircraft would have to stay

A Jaguar 96 of No 6 Squadron fitted with a Vinten VICON GP(1) recce pod over Mostar during a recent deployment in support of Operation *Deny Flight*. W Vinten Ltd via Jon Lake

team from St Athan at Boscombe Down. St Athan then produced six more GR1Bs, and two two-seat T2Bs. The last (tenth) single-seater was not converted, instead becoming the prototype Jaguar 96.

The nine GR1Bs and two T2Bs incorporated a MIL STD 1553B digital databus, and received a new Smiths Multi-purpose colour HDD, which could be used to display either a digital moving map, or TIALD imagery. To improve navigational accuracy, the aircraft received a Rockwell-Collins GPS, and was also fitted with a Raster-capable HUD, capable of showing FLIR imagery. A new stick-top and hand controller allowed HOTAS control of the TIALD pod. The opportunity was taken to 'tidy up' the Jaguar's cockpit layout, and the Sky Guardian RWR was upgraded. After the raising of the UOR in 1994, the TI GR1B flew on 11 January 1995, and TIALD equipped Jaguars flew their first missions over Bosnia on 27 May 1995. No 6 Squadron used the TIALD/Jaguar GR1B combination in anger on 30 August 1995, during Operation *Deliberate Force*, designating targets for LGB-carrying Harrier GR7s of No 4 Squadron, and demonstrating better accuracy than had been achieved by USAF F-111s and F-117s during the Gulf War.

The Jaguar is arguably the most capable and useful tactical aircraft the RAF has to meet the rapid deployment needs of the RAF in the post-Cold War world.

Although two of the UOR aircraft were twin-stickers, the opportunity was taken to provide a low-cost training tool to familiarise pilots with TIALD 'switchology'. DID of

in service for longer than had once been anticipated. Early Eurofighter funds were reallocated to maintain Jaguar capability for an extended period (to 'cover the gap') and the decision was soon taken to upgrade the entire Jaguar fleet to a similar standard as the GR1Bs, under a staged upgrade, whose annual phases became known as Jaguar 96 and Jaguar 97. The provision of a MIL STD 1553B databus has opened up the possibility of a much wider range of weapons, many of which were 'fit-checked' at Boscombe Down during 1995, from the BAe ALARM anti-radar missile to the new ASRAAM air-to-air missile. None have yet been funded for Jaguar, but mark a fascinating possibility for this veteran aircraft, along with weapons being procured for Tornado and Harrier like Brimstone or even CASOM.

The Jaguar 96 upgrade was directly managed by the Jaguar Support Authority within HQ Logistics Command, who oversaw and supervised a unique partnership between DERA (as upgrade designers), St Athan, industry and the front line. A very experienced Jaguar pilot was posted to Logistics Command and appointed as Jaguar Upgrade Project Officer, though he worked mainly from RAF Coltishall, from where he liaised with the front line and provided an up-to-the-minute operational perspective. New equipment was competitively sourced to replace older, increasingly hard to support systems. This was usually acquired on a spend-to-save

basis, though it inevitably improved operational capability as well.

The Jaguar 96 configuration includes the full gamut of *Granby* modifications (though these are applied using permanent Service Engineering Modifications, and not temporary STFs), together with the MIL STD 1553B databus, wide angle HUD and improved RWR (Radar Warning Receiver) associated with the GR1B. The aircraft also features an improved navigation suite, with a BASE Terprom Terrain Reference Navigation System complementing the GPS-embedded FIN.1064C INAS. All Jaguar 96s were wired to be able to carry TIALD and to be fitted with the GR1B type

used on operations and during preparatory training for operations, but not for routine peacetime training. Ever since, Jaguar 96s have formed the backbone of the Jaguar deployments to Gioia del Colle for operations over Bosnia. Full peacetime training will be permissable, and the aircraft will gain a new designation (GR3) when a new and separate Military Aircraft Release (full and formal release to service) is issued. This is due in August 1998. The GR3 designation will also apply to aircraft after they receive the second-stage of the upgrade, presently referred to by the designation Jaguar 97. Two-seaters converted to Jaguar 96 standards will

Above: A No 41(F) Squadron Jaguar on a low-level sortie over a Norwegian fjord during a recent deployment. John Cassidy

display screen, though only four or five aircraft were actually equipped with TIALD equipment from the GR1Bs, with the other GR1Bs giving up their control panels and display screens to equip the first two-seat Jaguar 97s. A new PC-based Mission Planner was acquired for use with Jaguar 96, but was not fully integrated.

Two-seaters converted to Jaguar 96 standards will not be frontline operational aircraft, since they still lack LRMTS, RWRs and inflight refuelling probe, and have no provision for the carriage of overwing missiles. The extent of the upgrade to the two-seater Jaguar 96s will be slightly less ambitious, though the aircraft will gain the new wide angle HUD, Terprom and the new GPS-embedded INS. Only the two T2Bs will be TIALD-equipped at this stage.

The Jaguar 96 upgrade has been managed and conducted extremely efficiently, allowing the RAF to act as the 'intelligent customer', carrying out the kind of 'smart procurement' which the new Labour Government's Strategic Defence Review is intended to encourage. The customer has obtained excellent value for money for the taxpayer, 'under budget and on time', while giving the front line exactly what it wants and needs. Many of the modifications have actually saved money, by making the aircraft more maintainable, more supportable and longer-lived.

Like the UOR (GR1B) aircraft the Jaguar 96 was rushed into service under an Operational Emergency Clearance, and later by a service deviation to the Jaguar GR1A's release to service. This provided for the aircraft to be

Suitably camouflaged during its deployment to Norway, this Jaguar carries a BAe reconnaissance pod on the centreline.

become T4s from about September 1998.

The Jaguar 96 upgrade brought all aircraft to a common wiring standard, but the hardware for TIALD and reconnaissance equipment was fitted to only a handful of aircraft. As such, there are presently three standards of Jaguar 96, and the type thus represents an interim configuration, though it does mark a major improvement over the basic GR1A. When modified to Jaguar 97 standards, all aircraft in the fleet will be wired to a genuinely common standard, with each and every aircraft able to carry TIALD or reconnaissance pods, and with all aircraft in the active long-term fleet fitted with the same cockpit displays and equipment.

Whereas the Jaguar 96 upgrade was very much the result of co-operation between DERA, RAF St Athan, and the front line, together with key industrial suppliers, the Jaguar 97 programme will enjoy the active involvement of BAe, the successors to the original designers (BAC and Breguet, under the collaborative SEPECAT umbrella) and original manufacturers of the RAF aircraft. BAe will consolidate the various GR3 modifications into the Master Drawing Set and provide expert advice on their design and incorporation. They will also produce Proof Installation and production drawings, although a team from RAF St Athan will actually convert the Proof Installation Jaguar 97 (XX116) at Boscombe Down, alongside a DERA team working on the Trial Installation prototype aircraft (XZ399). The Jaguar 97 TI is expected to make its maiden flight on 9 June 1998.

'Production' Jaguar 97 conversions will be undertaken by RAF St Athan. The Coltishall JAEDIT will produce the necessary instructions for the modifications, and will identify the parts required, using their type-experience to ease St Athan's task. Each member of the Jaguar 97 upgrade team will be playing to its strengths, and this should ensure that timescales are kept short, and that problems are minimised.

The Jaguar 97 will be equipped with a new state of the art multi-function LCD display to present TIALD imagery and a moving map display. This is larger than the display screen fitted to the Jaguar 96, and has better fidelity. More map area will be displayed, especially along the aircraft track. Moreover, the new screen is some three times cheaper than the old, and has a Mean-Time-Between-Failures of 7,500 hours, 15 times longer than that of the Jaguar 96 screen.

The Jaguar 97 also introduces a helmet-mounted sighting system. This was initially examined to allow the TIALD sensor to be aimed without the pilot having to look down into the cockpit, vital if the designator is to be used safely at low level, and useful at medium level. The helmet can also be used to position and enter a navigation fixing cross. Since then, the helmet sight has been integrated with the aircraft's Sidewinder AAM, allowing

the pilot to engage off-boresight air-to-air targets and thus dramatically improving self defence capability. If integrated with ASRAAM, the helmet sight would give the Jaguar an even more significant off boresight capability. Wiring provision for ASRAAM is provided as part of the Jaguar 97 programme, but full integration is not yet funded. The helmet sight could also theoretically allow the use of head-cued ASMs against off-boresight targets.

The Jaguar 97 will also incorporate software improvements to allow more accurate aiming of the Paveway II and Paveway III LGBs, and which will allow the TIALD to be used to measure slant range, instead of using the laser rangefinder. HUD symbology will be refined, with a g meter display in the HUD. The TRNS will also gain some improvements, which will reduce the number of 'nuisance warnings'. Software development connected with the Jaguar Upgrade has been extremely rapid, allowing the swift incorporation of 'bright ideas' from the frontline.

Finally, the Jaguar 97 will be fully integrated with the new PC-based Mission Planner. This represents a genuine use of COTS (Commercial Off The Shelf) equipment, and uses Windows-based software. The equipment incorporates the BASE Terprom's digital world map and allows the pilot to plan using superimposed reconnaissance and satellite imagery. The pilot can see much the same view of the target and terrain features as he will see from the cockpit, allowing the Mission Planner to be used for mission rehearsal. Cheap and remarkably portable, the Mission Planner can provide automatic routing around known threats, taking into account ECM, terrain elevation, etc. Terprom itself is integrated with the FIN 1064 INS and with the new GPS, and could provide the pilot with a terrain separation cue in the HUD, and with advisory terrain and obstacle warning. By keeping the aircraft symbol above a 'Not Go Below' line in the HUD, the pilot can effectively terrain follow, although the system is not cleared as being flight-safety critical, and so can only be regarded as advisory. When fully integrated, the Jaguar pilot will be able to load a mission directly from the Mission Planner into the aircraft's mission computer.

The single-seat Jaguar 97 will also carry the new Jaguar Replacement Reconnaissance Pod (JRRP), or EO GP(1). This is a development of Vinten's existing Series 18 Type 601 GP (1) pod, but uses electro-optical sensors instead of wet-film cameras.

The new sensors offer better definition and higher performance than the cameras they are replacing, and will require no wet-film processing support, since digital images from the sensors will be recorded directly to video tape. Officially classified as a shorter-range tactical reconnaissance pod than the Tornado's new RAPTOR pod, the EO GP(1) will nevertheless represent what is said to be the finest EO reconnaissance suite in service worldwide, and will offer considerable cost and manpower savings. Even more significantly, integration with the new Mission Planner will allow reconnaissance missions to be planned more easily, with automatic routing around threats, and with automatic offset tracks and sensor angles. The hard work of a recce sortie will be done on the ground, allowing the recce pilot greater situational awareness. Development of the JRRP is being carried out in parallel with the Jaguar 97 programme.

When modified to Jaguar 97 standards, all aircraft in the fleet will be wired to a genuinely common standard, with each and every aircraft able to carry TIALD or reconnaissance pods.

Two-seat Jaguar 97s will have the new mission planner integrated, and all will be wired for the carriage of TIALD. They will not receive the new AMLCD, however, but the eight Aircraft Establishment T4s will instead receive the original MPDs from the UOR aircraft. The aircraft will not be capable of carrying recce pods. Without RWR and LRMTS the T4 will continue to be a trainer rather than an operational aircraft.

Just as the Jaguar is being upgraded, so too is the TIALD pod which lies at the heart of its upgrade. Under a programme paralleling the Jaguar 97 project, the RAF's TIALD pods will be upgraded to TIALD 400 standards, with the VITS tracker and other enhancements and refinements.

Under a parallel programme, Oxley Developments have designed and supplied NVG compatible cockpit lighting kits, first for a Jaguar force 'night attack' cadre and then for the entire active fleet. The company has also designed and supplied NVG-covert external lights, allowing formation keeping by pilots wearing NVGs, but not visible to the naked eye.

The provision of a MIL STD 1553B digital databus and the provision of management methods to enable rapid software development means that further improvements to the Jaguar are limited only by funding and imagination. Advanced weapons aiming software and Direct Voice Input are two features which could be incorporated, and which would make the Jaguar an excellent lead-in vehicle for the first pilots destined for Eurofighter.

Perhaps more likely to see the light of day is an engine upgrade. The Jaguar has never been over-powered, and perhaps the most common item on Jaguar pilots' wish lists today would be increased engine thrust. The basic Adour Mk 104 fitted to RAF Jaguars is becoming increasingly difficult and expensive to support, and fitting a new engine could represent a spend-to-save modification, actually paying for itself, like so many of the improvements incorporated in the Jaguar upgrade.

At the time of writing (February 1998) it was expected that a contract would soon be signed with BAe to fit a new engine, with Rolls-Royce acting as sub-contractors. The new Adour Mk 106 will combine the cold section of the T-45 Goshawk's Adour Mk 871 with the reheat of the export Jaguar's Adour Mk 811. RAF Adour Mk 104s would be returned to works and 'new' Adour Mk 106s would be built from these engines, using a high proportion of new parts. The new engine should provide 25% greater thrust, be more maintainable and cost less to support.

The Jaguar upgrade keeps the RAF at the forefront of operational and tactical 'best practise', and the new equipment added balances cost and capability, taking the fullest possible advantage of the latest advances in science and technology. The upgrade has pioneered new methods and set new standards in logistics and engineering management practise. Moreover, the cost has been modest. The entire Jaguar 97 programme (over the full Jaguar fleet) has been estimated to cost £3m, less than the cost of three individual Tornado GR4 upgrades. Those involved in the Jaguar upgrade have been able to provide the front line with a quantum leap in capability with maximum efficiency and economy, providing excellent value for money for the taxpayer.

Upgrading to the new standard will provide the RAF's Jaguar fleet with much greater capability.

Celebrating 80 years

Ben Dunnell looks at the forthcoming events that will commemorate the RAF's 80th anniversary.

In a year in which the importance of air power has once again been clearly underlined, the Royal Air Force is marking its 80th year as an independent air arm, at five major airshows around the country and a number of smaller events.

The principal celebration of the 80th anniversary will take place at RAF Fairford, Gloucestershire on Saturday and Sunday 25-26 July, during **The Royal International Air Tattoo 1998**. Once again, the world's largest display of military aircraft is set to provide a number of very special anniversary showpieces in the air and on the ground, alongside its other major themes.

The Service's 80 years will be depicted in 80 minutes by 80 aircraft, with the culmination of the pageant presented through a series of five flypasts illustrating some of the notable aircraft types used for various key roles since 1918. These will cover fighters, bombers, training, communications/transport and Army co-operation/ground attack operations. The plan is for each group to come over the airfield at a different height, crossing the centre of the display line, at the same time.

During the course of the 80-minute RAF salute, it is intended to feature a wide cross-section of machines – among the fighters, biplane types should provide contrasts with such later classics as the Spitfire, Meteor and Hunter, while the Tornado F3 can be expected to provide the current in-service element and it is hoped that Eurofighter 2000 will be able to make its second Fairford appearance. RAF bombers should range from the Blenheim and Lancaster to Canberra and Tornado GR1, while the Army co-op/ground attack element also takes in a wide selection of aircraft from the Lysander and Hurricane, up to the present-day Jaguar GR1A and Harrier GR7.

It is hoped that Eurofighter 2000 will make its second Fairford appearance at RIAT 98. BAe

The *Red Arrows* will be taking part, tracing the RAF's roundel marking in the sky, accompanied by music from the Central Band of the RAF. 'Missing man' formations will be watched by 80 current and former RAF servicemen, one for each year of its history, taking the salute while aircraft from units of overseas air arms which have flown with the RAF will line up on the runway to represent this important part of its heritage. The static display will include aircraft representing most of the current RAF squadrons, as well as other units such as the University Air Squadrons and Volunteer Gliding Schools. An RAF Veterans' Enclosure will be open to all current and former personnel of the Service.

RIAT98 will also mark the 50th anniversary of the start of the Berlin Airlift, in which the RAF played a prominent part. A series of landings and take-offs at 90-second intervals by the Battle of Britain Memorial Flight's Lancaster (representing the Avro York/Lancastrian), a number of DC-3/C-47 Dakotas and two DC-4/C-54 Skymasters (from the Dutch Dakota Association and South African Airways' Historic Flight) will depict operations into Berlin's airports in 1948-49, while current transport aircraft from the units of Allied air arms that were involved half a century ago, will fly overhead. An enclosure for personnel involved in the Airlift will be open throughout the weekend, and many veterans from both sides of the Atlantic are expected to attend to witness this very special commemoration.

Top: RAF Tornados will again be returning to Fairford for the reconnaissance and squadron line-ups at RIAT 98. Peter R March

Above: The *Red Arrows* will be flying at most RAF events this summer. Ben Dunnell

The event's operational theme – *Skywatch '98* – is the first international gathering of reconnaissance and surveillance aircraft. Demonstrations of Police and Coastguard operations will contrast with current military types, many of which will be making rare appearances at a British airshow.

During the daily, eight-hour airshow there will be tributes to the RAF from a number of overseas air arms, including the Brazilian Air Force that plans to display the *Esquadrilha de Fumaça* (*Smoke Squadron*) with its six colourful EMB-312 Tucanos. The team will be

visiting Fairford as part of a two-month European tour, the first such visit undertaken by a Brazilian unit.

While not being on the same scale as RIAT 98, the **RAF Waddington International Air Show** on Saturday and Sunday 27-28 June, the RAF's premier display, will again bring together its own diverse multi-national line-up of military aircraft at this large Lincolnshire airfield. Naturally, RAF participation will dominate, including aircraft from Waddington's own resident units, Nos 8 and 23 Squadrons operating the Sentry AEW1, and No 51 Squadron flying the only three Nimrod R1s in service, in the ELINT-gathering role.

In the flying display, it is expected that most of the RAF's 1998 display aircraft will be in the air. The organisers are also hoping, like RIAT, that a Eurofighter Typhoon will be released from its intensive flight test programme, in order for the 21st century combat aircraft to make its first airshow appearance on a current RAF airfield. Overseas military representation is traditionally strong at Waddington, and it can be anticipated that a diverse selection of foreign flying and static items will be included in the programme. Warbirds will doubtless be another feature, with both piston and jet types depicting the RAF since 1918.

Amongst the historic RAF aircraft, this privately-owned Canberra B2 will feature in several of the anniversary line-ups. Ben Dunnell

Another major international airshow is held annually at **RAF Leuchars** in Fife, Scotland. This year it takes place on Saturday 12 September. Again, the majority of the RAF's solo and team performers will be on show at this, the home of Nos 43 and 111 Squadrons, and their Tornado F3s. Leuchars has gained a reputation for bringing in some interesting United States-based USAF participants in the last few seasons, along with aircraft from many other overseas air arms, shown both in the air and on the ground. Piston-engined and jet warbirds will be added to the historic RAF anniversary celebration.

For its RAF At Home Display on Sunday 14 June, **RAF Cosford** will be able to add its own special 80th anniversary element, as it has a large collection of historic RAF aircraft on the base at the Aerospace Museum. Part of the RAF Museum collection, it is one of Europe's leading military aircraft museums and has and has an unequalled range of former test and development types. When combined with a flying display which features a variety of both piston and jet warbirds, along with most of the RAF's display participants, this should again be a popular event.

In Cornwall, **RAF St Mawgan's** traditional mid-week **International Air Day** on Wednesday 5 August completes this 80th anniversary line-up. Always well-attended by an enthusiastic holiday crowd, a regular feature of this long-running event is the wide-ranging overseas representation as well as the expected RAF and civilian participation. The home of the RAF's Search and Rescue (SAR) helicopter engineering facility and No 203(R) Squadron, the Sea King OCU, it maintains its long established maritime connection. The IAD regularly provides a popular mix of classic jets and today's frontline aircraft, this year broadened to provide a celebration of the RAF's 80th anniversary.

Above: New faces for the *Red Arrows* in 1998 (from left): Flt Lt Andy Evans, Sqn Ldr Simon Meade (leader), Flt Lt Andy Lewis and Flt Lt Dicky Patouras. Phil Crow

Right: The spectacular Brazilian Air Force *Smoke Squadron* plans to fly its Tucanos at Fairford to salute the RAF's 80th anniversary. Peter R March

Airshow Salutes

1998 will be a memorable year for the RAF, the world s oldest independent air arm. In addition to the main events, the following airshows will have major RAF participation or will be saluting the 80th anniversary:

MAY

2-3 **Duxford, Cambs:** Spitfire 60th Anniversary Air Show
23-24 **RAF Mildenhall, Suffolk:** Air Fete 98
24-25 **Southend-on-Sea Seafront, Essex:** Southend Airshow

JUNE

6 **Woodford, Cheshire:** RAFA/BAe Airshow
6-7 **Biggin Hill, Kent:** 36th International Air Fair
13-14 **Middle Wallop, Hants:** Middle Wallop International Airshow

JULY

4-5 **Duxford, Cambs:** The Fighter Collection Flying Legends Air Show
15 **RNAS Culdrose, Cornwall:** International Air Day
18 **RNAS Yeovilton, Somerset:** International Air Day

AUGUST

1-2 **Sunderland, Tyne & Wear:** Sunderland International Air Show
29-30 **Southport Seafront, Lancs:** Southport Airshow
29-31 **Elvington, N Yorks:** Yorkshire Air Spectacular

SEPTEMBER

5 **Cardiff, S Glamorgan:** Air Day Wales
5-6 **Shoreham, West Sussex:** RAFA Shoreham Airshow
6 **Folkestone Seafront, Kent:** Shepway Festival Airshow
6 **Duxford, Cambs:** Duxford 98 Air Display
7-13 **Farnborough, Hants:** SBAC International Air Show
17 **St Peter Port Harbour, Guernsey, CI:** Battle of Britain Air Display
17 **St Helier Sea Front, Jersey, CI:** Battle of Britain Airshow

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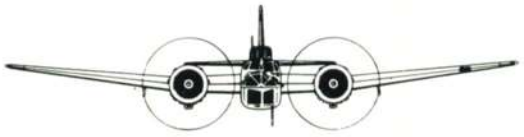

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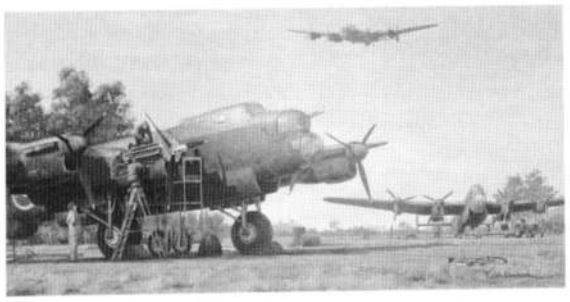

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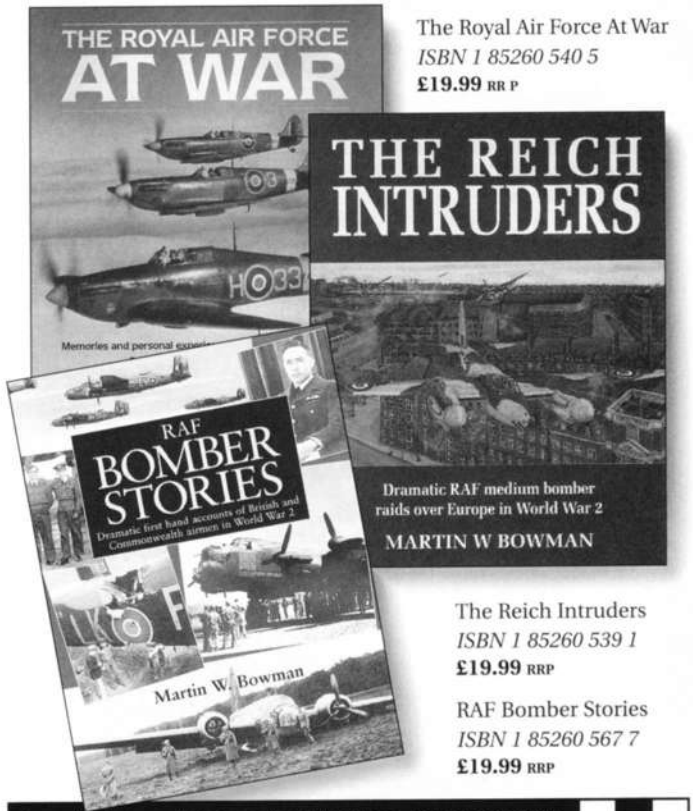

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THE RAF'S YEAR 1997

Brian Strickland reviews some of the highlights of 1997.

JANUARY

• IFOR in Bosnia was replaced by **SFOR** (Stabilisation Force).

• An **E-3D Sentry AEW1** was deployed from RAF Waddington to the Caribbean, sponsored by the Franco-British European Air Group at High Wycombe as part of a long-range deployment to demonstrate out-of-area interoperability between the RAF and units of the French Air Force, with particular emphasis on air-to-air refuelling.

FEBRUARY

• The last two **Westland Wessex** helicopters of **No 60 Squadron** left RAF Benson and flew to the RNAY at Fleetlands for storage, on 11 February.

• The Ministry of Defence announced that the **Tri-National Tornado Training Establishment** at RAF Cottesmore was to close on 31 March 1999. It was also announced that the RAF's Harrier Force was to be consolidated at Cottesmore and Wittering, following the closure of Laarbruch in 1999.

• Three Nimrod MR2s, that had been in deep storage at RAF Kinloss, were transported by air on three Antonov An-124 flights, to Bournemouth Airport for rebuilding by FRA, as part of the £2 billion contract for the RAF's new **Nimrod 2000** maritime patrol aircraft.

Jeremy Flack/API

MARCH

Peter R March

• The world's last flying **Comet 4C** completed 34 years of service at Boscombe Down and was grounded. *Canopus* was later purchased by tender and flown to Bruntingthorpe, Leics for preservation.

• No 18 Squadron's Puma Flight completed its move from Laarbruch to join **No 72 Squadron** at Aldergrove, Northern Ireland, as a result of the restructuring of the RAF's Support Helicopter Force and the withdrawal of the Puma from Germany.

• **No 2 Flying Training School**, based at Shawbury, disbanded on 30 March for the fifth time since it formed in 1920 at Duxford. It handed over the *ab-initio* helicopter aircrew training task to the new tri-service Defence Helicopter Flying School two days later.

APRIL

• On 1 April the Search and Rescue Training Unit (SARTU) at RAF Valley became part of the **Defence Helicopter Flying School** (DHFS), which formed the same day at RAF Shawbury.

• **No 60 Squadron** disbanded as an operational flying unit at RAF Benson on 1 April. It reformed later in the month as a training unit at Shawbury as No 60(R) Squadron.

• Air Chief Marshal Sir Michael Graydon handed over as Chief of the Air Staff to **Air Chief Marshal Sir Richard Johns** on 9 April.

• The new **Operations Support Branch** was established with five specialisations: air traffic control, fighter control, intelligence, RAF Regiment and the new specialisation of flight operations.

MAY

• The new **Sea King HAR3A** Search and Rescue (SAR) helicopter entered RAF operational service with A Flight, No 22 Squadron at RMB Chivenor.

• The Air Defence Division of Siemens Plessey Systems handed over the first of six AR327 Commander **air defence radars** to No 1 Air Control Centre.

• **Exercise Northern Venture** commenced when an RAF expedition left London City Airport to fly two Chipmunks around the world, via Russia, Canada and the North Atlantic. It was successfully completed in July when the aircraft flew into the Royal International Air Tattoo at RAF Fairford.

JUNE

Peter R March

• On 3 June the six Wessex helicopters of **No 28 (Army Co-operation) Squadron** made a final flight around Hong Kong, before they were handed over to the Uruguayan Air Force. No 28, the last RAF squadron in Hong Kong, was disbanded.

• It was announced that the RAF was to recruit reservist air traffic controllers for operational and instructional duties at seven airfields in **Personnel and Training Command**.

• **No 33 Squadron** Pumas flew into RAF Benson on 13 June, having transferred from their long-time base at RAF Odiham.

• A new high visibility black colour scheme appeared for the first time on a **Dominie** at the RAF College, Cranwell, after the aircraft returned from overhaul at St Athan.

Opposite page: Eurocopter Squirrels were acquired for use by the new tri-service Defence Helicopter Flying School at RAF Shawbury in April. Andrew March

Left: The production go-ahead for the Eurofighter EF2000 Typhoon was achieved in December. BAe

JULY

• The last two Chinooks of **No 18 Squadron** left RAF Laarbruch, Germany.

• Hughes Danbury Optical Systems won a $5 million contract to supply its laser warning system for the RAF's **EH-101** support helicopters.

AUGUST

Peter R March

• **Westland Gazelle HT3s**, that had served as the RAF's basic helicopter trainer since 1973, were retired from the service on 31 August. They were replaced by Squirrel HT1s at the DHFS.

• After nearly 20 years, the final air-to-air gunnery sortie was flown from No 4 FTS at **RAF Valley**.

• The first group of Hercules reserve aircrew completed their re-familiarisation training with **No 57(R) Sqn** at Lyneham.

• On 31 August a Northolt based BAe 146 of **No 32 (The Royal) Squadron** carried out the sombre task of returning the body of Diana, Princess of Wales to Britain.

SEPTEMBER

• The RAF's long-standing association (since 1970) with operational flying training in Sardinia ended when the last air weapons detachment finished at **Decimomannu** on 26 September.

• For the first time in the station's 45 year history, the **Boulmer** operations site was without an operational air defence radar as its Type 91 radar was formally switched off and the site closed. The Type 93 radar at Brizlee Wood took over this responsibility.

OCTOBER

BAe

• The first **Tornado GR4** conversion was delivered to the RAF at DERA Boscombe Down on 31 October.

• On the 50th anniversary of the first supersonic flight, **Sqn Ldr Andy Green**, an RAF Tornado F3 pilot, became the first person to set a supersonic land speed record in the jet-powered **Thrust SSC**, when he recorded an average speed of 763.035mph across the Nevada Desert.

• **Flt Lt Ian Black** of the Royal Auxiliary Air Force became the first reserve fighter pilot to fly with the RAF since 1957.

• A new Colour was presented to **RAF Halton** by HM The Queen, the first to be awarded to the RAF since 1969.

• **RAF North Luffenham** closed on 23 October and the Ground Radio Servicing Centre relocated to Sealand in November, where third line servicing continued. The Aviation Medicine Training Centre ceased training in January 1998 and subsequently combined with the School of Aviation Medicine at Henlow, to form the Centre of Aviation Medicine.

NOVEMBER

• The Government announced the formation of four new **Royal Auxiliary Air Force** squadrons to support front-line operations or humanitarian duties – based at Cottesmore, Marham, Brize Norton/Lyneham and Leeming.

• Seven **Harrier GR7s** of No 1 Sqn at RAF Wittering, flew to join HMS *Invincible* in the Mediterranean as part of the operational air group on standby to move to the Gulf in the event of a decision to mount air strikes against Iraq.

Patrick Allen

DECEMBER

• As part of a major reorganisation, the **Aeronautical Rescue Co-ordination Centre** at Plymouth closed on 12 December. Responsibility for its southern military and aeronautical co-ordination area was handed over to its northern counterpart, the ARCC at Kinloss.

• The Defence Secretary signed the inter-governmental arrangements for the **Eurofighter EF2000 Typhoon** to go into full production. The UK intends to buy 232 aircraft to replace the Tornado F3 and Jaguar. Deliveries are scheduled to begin in June 2002 and run until 2014.

• In a ceremony on 6 December, the Boeing Company formally handed-over the first new-build **Chinook HC2A** to the RAF. A further 13 HC2A and HC3s, manufactured for the RAF under a 1995 contract, will be delivered over the next three years.

In June, a new high-visibility scheme appeared on a Dominie of the RAF College, Cranwell. Phil Crow

The Royal Air

Peter R March

Puma HC1 – No 33 Sqn, Benson. Brian Strickland

VC10 K2 – No 101 Sqn, Brize Norton. PRM

Squadron	Aircraft type(s)	Location
1 Sqn	Harrier GR7/T10	Wittering
2 Sqn	Tornado GR1/1A	Marham
3 Sqn	Harrier GR7/T10	Laarbruch
4 Sqn	Harrier GR7/T10	Laarbruch
5 Sqn	Tornado F3	Coningsby
6 Sqn	Jaguar GR1A/B/T2A	Coltishall
7 Sqn	Chinook HC2/2A	Odiham/Aldergrove
8 Sqn	Sentry AEW1	Waddington
9 Sqn	Tornado GR1	Brüggen
10 Sqn	VC10 C1K	Brize Norton
11 Sqn	Tornado F3	Leeming
12 Sqn	Tornado GR1/1B	Lossiemouth
13 Sqn	Tornado GR1/1A	Marham
14 Sqn	Tornado GR1	Brüggen
15(R) Sqn (TWCU)	Tornado GR1	Lossiemouth
16(R) Sqn (JOCU)	Jaguar GR1A/T2A	Lossiemouth
17 Sqn	Tornado GR1	Brüggen
18 Sqn	Chinook HC2	Laarbruch
19(R) Sqn (4 FTS)	Hawk T1/T1A	Valley
20(R) Sqn (HOCU)	Harrier GR7/T10	Wittering
22 Sqn HQ		Chivenor
A Flt	Sea King HAR3A	Chivenor
B Flt	Sea King HAR3A	Wattisham
C Flt	Sea King HAR3	Valley
23 Sqn (inc SOCU)	Sentry AEW1	Waddington
24 Sqn	Hercules C1/C3	Lyneham
25 Sqn	Tornado F3	Leeming
27 Sqn	Chinook HC2	Odiham
29 Sqn	Tornado F3	Coningsby
30 Sqn	Hercules C1/C3	Lyneham
31 Sqn	Tornado GR1	Brüggen
32 (The Royal) Sqn	BAe125 CC3; Twin Squirrel BAe 146 CC2; Wessex HCC4	Northolt

Squadron	Aircraft type(s)	Location
33 Sqn	Puma HC1	Benson
39 (1PRU) Sqn	Canberra PR9/PR7/T4	Marham
41 Sqn	Jaguar GR1A/T2A	Coltishall
42(R) Sqn (NOCU)	Nimrod MR2	Kinloss
43 Sqn	Tornado F3	Leuchars
45(R) Sqn (3 FTS/METS)	Jetstream T1	Cranwell
47 Sqn	Hercules C1/C3	Lyneham
51 Sqn	Nimrod R1	Waddington
54 Sqn	Jaguar GR1A/B/T2A	Coltishall
55(R) Sqn (3 FTS)	Dominie T1(mod)	Cranwell
56(R) Sqn (F3OCU)	Tornado F3	Coningsby
57(R) Sqn (HOCU)	Hercules C1/C3	Lyneham
60(R) Sqn (DHFS)	Griffin HT1	Shawbury/Valley
70 Sqn	Hercules C1/C3	Lyneham
72 Sqn	Wessex HC2/Puma HC1	Aldergrove
74(R) Sqn (4 FTS)	Hawk T1/T1A	Valley
78 Sqn	Chinook HC2; Sea King HAR3	Mount Pleasant
84 Sqn	Wessex HC2	Akrotiri
100 Sqn (inc JFACTSU)	Hawk T1/T1A	Leeming
101 Sqn	VC10 K2/K3/K4	Brize Norton
111 Sqn	Tornado F3	Leuchars
120 Sqn	Nimrod MR2	Kinloss
201 Sqn	Nimrod MR2	Kinloss
202 Sqn HQ		Boulmer
A Flt	Sea King HAR3	Boulmer
D Flt	Sea King HAR3	Lossiemouth
E Flt	Sea King HAR3	Leconfield
203(R) Sqn (SKOCU)	Sea King HAR3	St Mawgan
206 Sqn	Nimrod MR2	Kinloss
208(R) Sqn (4 FTS)	Hawk T1/T1A	Valley
216 Sqn	Tristar K1/KC1/C2/C2A	Brize Norton
230 Sqn	Puma HC1	Aldergrove
617 Sqn	Tornado GR1B	Lossiemouth

Force 1998 SQUADRONS & UNITS (as at April 1998)

Bulldog T1 – 3 FTS/CFS, RAF Cranwell. Phil Crow

OVERSEAS BASED FLIGHTS & OPERATIONAL DETACHMENTS

(aircraft and crews from squadrons listed on previous page)

1312 Flt	VC10 K2/3/4 (101 Sqn); Hercules C1	Mount Pleasant, FI
1435 Flt	Tornado F3	Mount Pleasant, FI
Operation *Warden*	Tornado GR1/1A/1B; VC10 C1K (10 Sqn)	Incirlik, Turkey
Operation *Jural*	Tornado GR1	Al Kharj, Saudi Arabia
	VC10 K2/3/4 (101 Sqn)	Muharraq, Bahrain
Operation *Bolton*	Harrier GR7 (1 Sqn)	HMS *Invincible*
	Harrier GR7 (3 Sqn)	HMS *Illustrious*
	Tornado GR1/1A/1B (14 Sqn)	Ali Al Salem, Kuwait
Operation *Deliberate Guard*	Jaguar GR1A/3	Gioia del Colle, Italy
	Tristar K1 (216 Sqn)	Ancona, Italy
	Sentry AEW1 (8/23 Sqn)	Aviano, Italy
Operation *Lodestar*	Chinook HC2 (1310 Flt)	Split, Croatia

OTHER FLYING UNITS

1 FTS	Tucano T1	Linton-on-Ouse
1 FTS (CFS)	Tucano T1	Topcliffe
3 FTS (inc CFS)	Bulldog T1	Cranwell
4 FTS (inc CFS)	Hawk T1/T1A	Valley
Joint Elementary Flying Training School (JEFTS)	T67M Firefly	Barkston Heath/ Newton
Defence Helicopter Flying School	Squirrel HT1 660 Sqn (AAC)/705 Sqn (RN)	Shawbury
	Griffin HT1 – 60 Sqn/SARTU	Shawbury/Valley
Air Warfare Centre (HQ)		Waddington
(Strike/Attack OEU)	Harrier GR7; Jaguar GR3/T2B; Tornado GR1/1A/1B	Boscombe Down
(F3 OEU)	Tornado F3	Coningsby
Tri-National Tornado Training Establishment (TTTE)	Tornado GR1	Cottesmore
Northolt Stn Flt	Islander CC2/2A	Northolt
St Athan Stn Flt	Tucano T1	St Athan
Red Arrows	Hawk T1/T1A	Cranwell/Scampton
Battle of Britain Memorial Flight	Spitfire IIA, VB, IX, XIX; Hurricane; Lancaster; Chipmunk; Dakota	Coningsby
No 1 Parachute Training School (inc *Falcons* Display Team)	Hercules C1/C3 (from Lyneham Wing); Skyvan (Hunting)	Brize Norton

UNIVERSITY AIR SQUADRONS AND AIR EXPERIENCE FLIGHTS

University of Birmingham AS inc No 8 Air Experience Flight	Bulldog T1	Cosford
Bristol UAS inc No 3 Air Experience Flight	Bulldog T1	Colerne
Cambridge UAS inc No 5 Air Experience Flight	Bulldog T1	Cambridge Airport
East Lowlands UAS	Bulldog T1	Leuchars
East Midlands UAS inc No 7 Air Experience Flight	Bulldog T1	Newton
Universities of Glasgow and Strathclyde AS	Bulldog T1	Glasgow Airport
Liverpool UAS inc No 10 Air Experience Flight	Bulldog T1	Woodvale
University of London AS inc No 6 Air Experience Flight	Bulldog T1	Benson
Manchester and Salford Universities AS	Bulldog T1	Woodvale
Northumbrian Universities AS inc No 11 Air Experience Flight	Bulldog T1	Leeming
Oxford UAS	Bulldog T1	Benson
Southampton UAS inc No 2 Air Experience Flight	Bulldog T1	Boscombe Down
University of Wales AS	Bulldog T1	St Athan
Yorkshire Universities AS inc No 9 Air Experience Flight	Bulldog T1	Church Fenton

The Royal Air Force 1998

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615 VGS	Viking TX1	Kenley
616 VGS	Vigilant T1	Henlow
617 VGS	Viking TX1	Manston
621 VGS	Viking TX1	Hullavington
622 VGS	Viking TX1/Valiant TX1	Upavon
624 VGS	Vigilant T1	Chivenor
625 VGS	Viking TX1	Hullavington
626 VGS	Viking TX1	Predannack
631 VGS	Viking TX1/Valiant TX1	Sealand
632 VGS	Vigilant T1	Ternhill
633 VGS	Vigilant T1	Cosford
634 VGS	Viking TX1	St Athan
635 VGS	Vigilant T1	Samlesbury
636 VGS	Viking TX1	Aberporth
637 VGS	Vigilant T1	Little Rissington
642 VGS	Vigilant T1	Linton-on-Ouse
645 VGS	Viking TX1	Syerston
661 VGS	Viking TX1	Kirknewton
662 VGS	Viking TX1	Arbroath
663 VGS	Vigilant T1	Kinloss
664 VGS	Vigilant TX1	Belfast City/ Newtownards
Air Cadet CGS (+644VGS)	Kestrel TX1, Valiant TX1, Vigilant T1, Viking TX1	Syerston

Harrier GR7 – No 3 Sqn, Laarbruch. PRM

Tornado GR1 – No 13 Sqn, Marham. PRM

Tornado F3 – No 5 Sqn, Coningsby. PRM

Jaguar GR1B – No 6 Sqn, Coltishall. PRM

AIR DEFENCE GROUND ENVIRONMENT

United Kingdom		
	RAF Benbecula	Control and Reporting Post
	RAF Boulmer	Control and Reporting Centre
	RAF Buchan	Control and Reporting Centre
	RAF Neatishead	Control and Reporting Centre
	RAF St Mawgan (Portreath)	Control and Reporting Post
	RAF Saxa Vord	Control and Reporting Post
	RAF Staxton Wold	Reporting Post
Falkland Islands		
	Byron Heights	Control and Reporting Post
	Mount Alice	Control and Reporting Post
	Mount Kent	Control and Reporting Centre

RAF REGIMENT

1 Squadron	RAF Laarbruch	Field Squadron
2 Squadron	RAF Honington	Field/Para Squadron
3 Squadron	RAF Aldergrove	Field Squadron
15 Squadron	RAF Honington	Rapier FSC Squadron
16 Squadron	RAF Honington	Rapier FSC Squadron
26 Squadron	RAF Laarbruch	Rapier FSC Squadron
27/48 Squadron	RAF Waddington	Rapier Squadron
34 Squadron	RAF Leeming	Field Squadron
37 Squadron	RAF Bruggen	Rapier FSC Squadron
63 Squadron	RAF Uxbridge	Field Squadron/ Queen's Colour Squadron
Rapier FSC OCU	RAF Honington	Rapier Conversion Unit

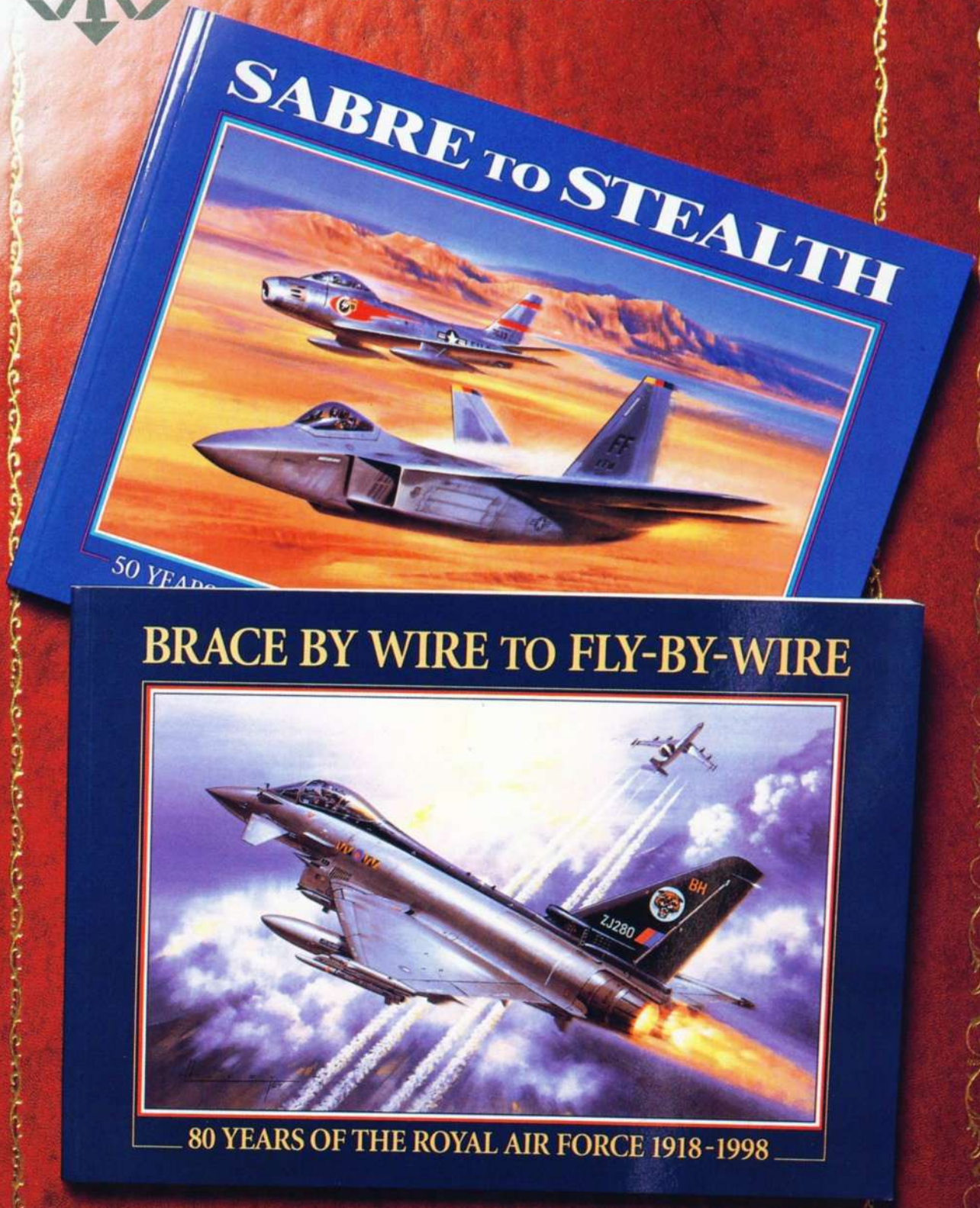
ROYAL AUXILIARY AIR FORCE

No 1 Maritime Headquarters Unit	RAF Northolt
No 2 Maritime Headquarters Unit	Edinburgh
No 3 Maritime Headquarters Unit	RAF St Mawgan
Helicopter Role Support Squadron	RAF Benson
Offensive Support Role Support Squadron	RAF Cottesmore
Strike Attack Role Support Squadron	RAF Marham
Air Transport & AAR Role Support Squadron	RAF Brize Norton
Air Transport & AAR Role Support Flight	RAF Lyneham
Air Defence Role Support Squadron	RAF Leeming (from July 1998)
4624 Air Movements Squadron	RAF Brize Norton
4626 Aeromedical Evacuation Squadron	RAF Lyneham
7006(VR) Intelligence Squadron	RAF High Wycombe
7010(VR) Photographic Interpretation Squadron	DISC Chicksands*
7630(VR) Intelligence Squadron	DISC Chicksands*
7644(VR) Public Relations Squadron	RAF Waddington
The Air Transportable Surgical Squadron	RAF Leuchars
2503 RAuxAF Regiment Field Squadron	RAF Waddington
2622 RAuxAF Regiment Field Squadron	RAF Lossiemouth
2625 RAuxAF Regiment Field Squadron	RAF St Mawgan
Training and Standarisation Squadrons	RAF Halton/ Shawbury

* Defence Intelligence and Security Centre Chicksands, Beds

AVIATION

Gift Collection



A Tribute in words and Pictures

Sabre To Stealth
Product Code 780587
Price £15.95
ISBN 1-899808-95-7
This remarkable tribute to the United States Air Force following its 50th Anniversary celebrations is now available in paperback form. 'Sabre To Stealth' traces the history from the creation of the first F-86 Sabre Jet Fighter, through to today's cutting edge Stealth technology in the form of the F-22 ultimate war plane from Lockheed Martin. This outstanding highly acclaimed volume is heavily illustrated with paintings by over 30 eminent aviation artists as well as including impressive photography illustrating the achievements of the most powerful Air Force in the world.

Brace By Wire To Fly-By-Wire
Product Code 780503
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ISBN 1-899808-06-X
A lavish year-by-year history of the Royal Air Force and updated to coincide with the 80th Anniversary celebrations. Each of the 80 years is described with a broad account, followed by a diary of events. A colour painting by a leading aviation artist accompanies each year illustrating an aircraft in RAF service at the time, or a relevant scenario. This unique volume has a forward by His Royal Highness The Duke Of Kent KG GCMG GCVO ADC, with an introduction from The Prime Minister - The Right Honourable Tony Blair, the Chief of Air Staff, RAF, and the Chief of the Defence Staff, MOD.

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Price CD £12.95 Cassette £7.95
This unique recording captures for all time the celebration of the RAF's 80th Anniversary.
Music to include Mars from the "Planet Suite",Fighter Command March,Songs of WWII, The Dambusters March, Festive Overture by Shostakovich, Eleanor Rigby,World in Union, Star Wars,Grand Sunset Ceremony Finale.

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Stylish 'classic' polo shirt made form 65% polyester and 35% cotton. Machine washable with hand embroidered logos. Support the RAFBF Enterprises and wear them with pride.

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Classically styled for comfort and can be worn all year round. Made from durable 50% cotton and 50% polyester. Machine washable.

'Battle for the Skies' Videos Boxed Set
Product Code 250060
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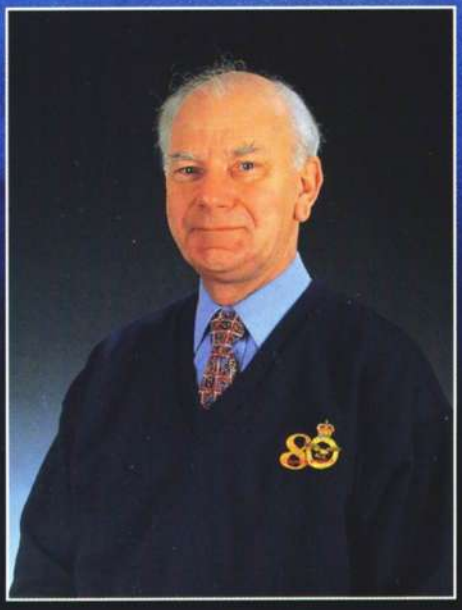
'Battle For The Skies' is one of the most detailed and visually stunning aviation video series ever made and provides an accurate film history of the RAF from the early days of the Air Battalion and the Royal Flying Corps right upto its front line role of today. Every significant aircraft flown by the RAF and every major action it has taken part in during its eighty year history are all featured. Drawing on 27 film archives from around the world, 'Battle For The Skies' features exclusive new film footage never previously shown. This 'ultimate' aviation collectors set of videos provides a fitting and lasting tribute to the achievements of the Royal Air Force in this its 80th Anniversary.
The history of the Royal Air Force set of seven cassettes with free luxury slipcase. RRP £90.98 Save £12.99. Running time seven hours (approx).



80th Anniversary Logo V-Neck Sweatshirt
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The Tradition is Safe

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Eurofighter 2000
Product Code 430460
Price £29.00

'DIORAMA' Eurofighter 2000/Bristol F2B Fighter
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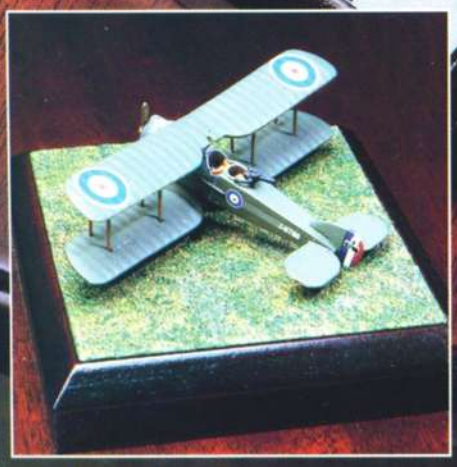


Bristol F2B Fighter
Product Code 430465
Price £29.00

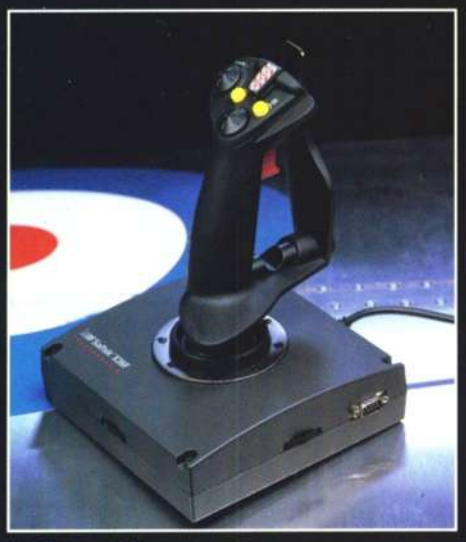
To celebrate the 80th Anniversary of the Royal Air Force, the 'Aviation Gift Collection' is proud to announce the launch of a new exclusive range of hand sculpted aviation collectables - traditionally crafted in finest English Pewter.

These unique designs form the foundation for a 'collectable series' which will be ongoing and available through future issues of the 'Aviation Gift Collection' direct mail order catalogues. All the aircraft are authentically made to exact scale. We begin the collection with the Bristol F2B Fighter and the Eurofighter 2000, appropriately spanning the 80 year spectrum. All aircraft are meticulously painted by hand and using air brush techniques. Each also has a 15mm deep wooden base. In addition to the aircraft, we are also introducing a range of 90mm pilot figures, the first in a collectible series is a 'diorama' depicting a 1918 pilot shaking hands with a test pilot of the present day.

The figurines are mounted on a similar base to the aircraft. Finally, with an imaginative and symbolic gesture, on both 'dioramas' we have mounted a brass photo-etched plaque with the inscription 'THE TRADITION IS SAFE' - with your help and support , we are sure it is. Look out for new forthcoming models - The Vulcan, The Lightning, The Hawker Hunter and the British Bulldog.

Feel the Power

'You Can Make It Friend' Mousemat & Coasters
Product code 450404
Price £6.95
Following its fantastic success as a Christmas card in 1997, this much sort after painting by renowned aviation artist Wilfred Hardy G.Av.A, has now been re-introduced as a striking mousemat and coaster set.



X36F Joystick
Product Code 920065
Price £62.99
The ultimate programmable control stick with optional throttle rudder system. The combination of the two represents the ultimate in flexibility, programmability and comfort. Puts all the controls you need at your finger tips. PC compatible.

X35T Throttle
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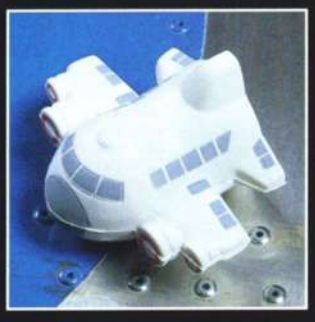
Eurofighter Mousemat and Coasters
Product code 450406
Price £6.95
This 1998 Wilf Hardy masterpiece has scaled new heights of aviation artistry and design - certain to become an all time classic.

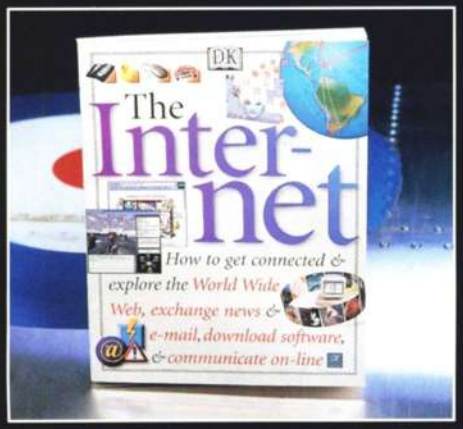


Stress Airplane
Product Code 910450
Price £3.50
Stay 'Stress free with RAFBFE', this attractive anti-stress aircraft makes a perfect and inexpensive gift.

Flying Corps Gold
Product Code 920070
Price £29.99
The ultimate in WWI flight simulation!. Complete with full manual of information, tactics and detailed historical accounts of the major air campaigns featured in the game as well as full installation and loading instructions. Flying Corps Gold is in CD ROM format and minimum computer specifications are Pentium 133,16mb RAM, 14 Mb free hard disk space, quad speed CD Rom, mouse, windows 95 or MS DOS.

Vulcan Mousemat and Lightning Coasters
Product Code 450402
Price £6.95
Retained by popular demand, this evocative portrayal of the Vulcan-'The Ghost From Goose Bay', together with the ever popular Lightning - 'Fourteen Tons of Thunder', completes the third in a set of Wilf Hardy's impressive works.

F22
Product Code 920050
Price £29.95
F22 blends fast and furious air combat with gripping real-time strategy in a unique flight simulator experience. Minimum Specification P133, 16mb RAM, 70mb hard drive space, SVGA graphics card, Windows 95, double speed CD-ROM, Microsoft compatible mouse.



The Internet Book
Product Code 710009
Price £14.99
Unrangle the 'INTERNET' maze with this full colour jargon free, practical introduction to the Internet. Includes a web-site directory.

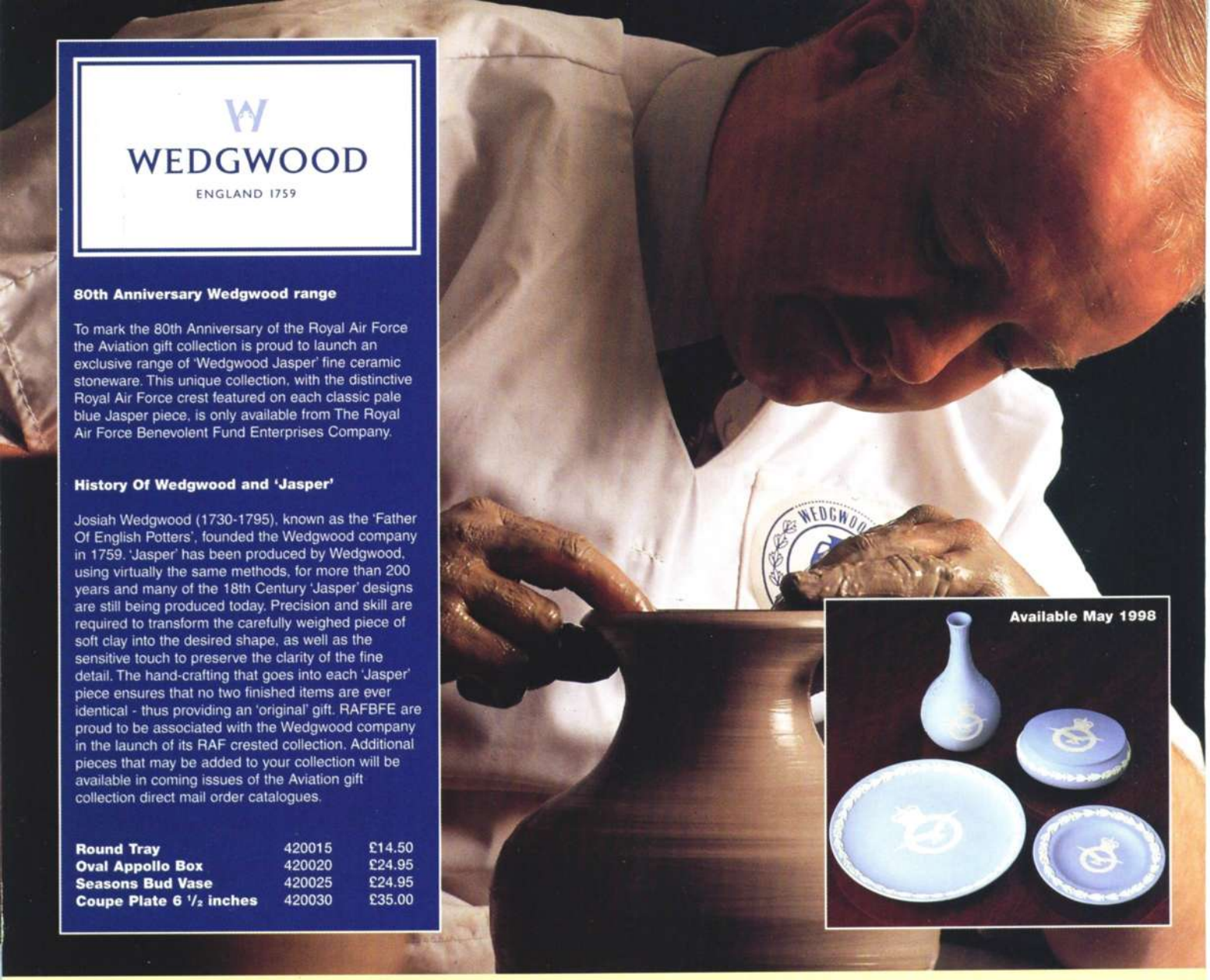
CD ROM Case
Product Code 920020
Price £9.99
This lightweight leather-look case is the ideal way to protect your CD's. Excellent value for money. Holds 10 discs.

21st Century Team by Wilfred Hardy GAvA

The Royal International Air Tattoo AvIATion Collection Series: Print No 1

Aggressor in Action by Wilfred Hardy GAvA

The Royal International Air Tattoo AvIATion Collection Series: Print No 2



WEDGWOOD
ENGLAND 1759

80th Anniversary Wedgwood range

To mark the 80th Anniversary of the Royal Air Force the Aviation gift collection is proud to launch an exclusive range of 'Wedgwood Jasper' fine ceramic stoneware. This unique collection, with the distinctive Royal Air Force crest featured on each classic pale blue Jasper piece, is only available from The Royal Air Force Benevolent Fund Enterprises Company.

History Of Wedgwood and 'Jasper'

Josiah Wedgwood (1730-1795), known as the 'Father Of English Potters', founded the Wedgwood company in 1759. 'Jasper' has been produced by Wedgwood, using virtually the same methods, for more than 200 years and many of the 18th Century 'Jasper' designs are still being produced today. Precision and skill are required to transform the carefully weighed piece of soft clay into the desired shape, as well as the sensitive touch to preserve the clarity of the fine detail. The hand-crafting that goes into each 'Jasper' piece ensures that no two finished items are ever identical - thus providing an 'original' gift. RAFBFE are proud to be associated with the Wedgwood company in the launch of its RAF crested collection. Additional pieces that may be added to your collection will be available in coming issues of the Aviation gift collection direct mail order catalogues.

Round Tray	420015	£14.50
Oval Appollo Box	420020	£24.95
Seasons Bud Vase	420025	£24.95
Coupe Plate 6 ½ inches	420030	£35.00

ORDER FORM

Please return to: Dept SYB 098, PO Box 1940, Fairford, Gloucestershire, GL7 4NA, England. Fax: 01285 713999

PLEASE COMPLETE IN BLOCK CAPITALS

Name Mr/Mrs/Miss/Ms

Address

Postcode

Code	Description	Colour	Size	Qty	Price

Post & Packaging

Order Value	UK
Up to £9.99	£2.50
£10-£39.99	£3.45
£40+	£4.95

For Overseas Rates please ring: 01285 713456.
Please allow 28 days for delivery in the UK.
All sizes are approximate

Goods Total	£
P & P	
Grand Total	£

Photocopies of this order form will be acceptable.

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☐ I wish to pay by cheque, made payable to RAFBF Enterprises

☐ Visa ☐ Mastercard

☐ Postal Order ☐ International Money Order

Card Number ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Country Daytime Tel. No. Expiry Date / /

Cardholder's Name

Signature

PAYMENT BY CHEQUES, POSTAL ORDERS & INTERNATIONAL MONEY ORDERS:

Cheques must be drawn on a UK Bank.

Payment must be made in Sterling.

☐ I am over 18 years of age. Please send me my copy of The Aviation Gift Collection Catalogue.

☐ I am 18 -49 years ☐ I am 50 years+

From time to time, The Royal Air Force Benevolent Fund Enterprises may wish to send you details of other services which may be of interest to you. If you do not wish to receive information please tick this box. ☐

BREITLING
1884

OLD NAVITIMER

Favored by pilots and aircrews since 1952, the OLD NAVITIMER mechanical chronograph displays the classic good looks of a 1950s-style timepiece, with slide rule built into a ruggedly water-resistant steel case. Early NAVITIMER models were a familiar sight in the cockpit of the Lockheed Constellation, whose four 2250-hp motors provided this airliner with a range of more than 2,400 miles at a cruising altitude of over 16,000 feet.

Mechanical chronograph

Providing a power reserve of a least 42 hours, the OLD NAVITIMER self-winding chronograph measures times from 1/5th second to 12 hours plus intermediate and cumulative flying times when needed.
Available in steel, steel and gold or 18K gold. Leather strap; NAVITIMER or PILOT bracelet.

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