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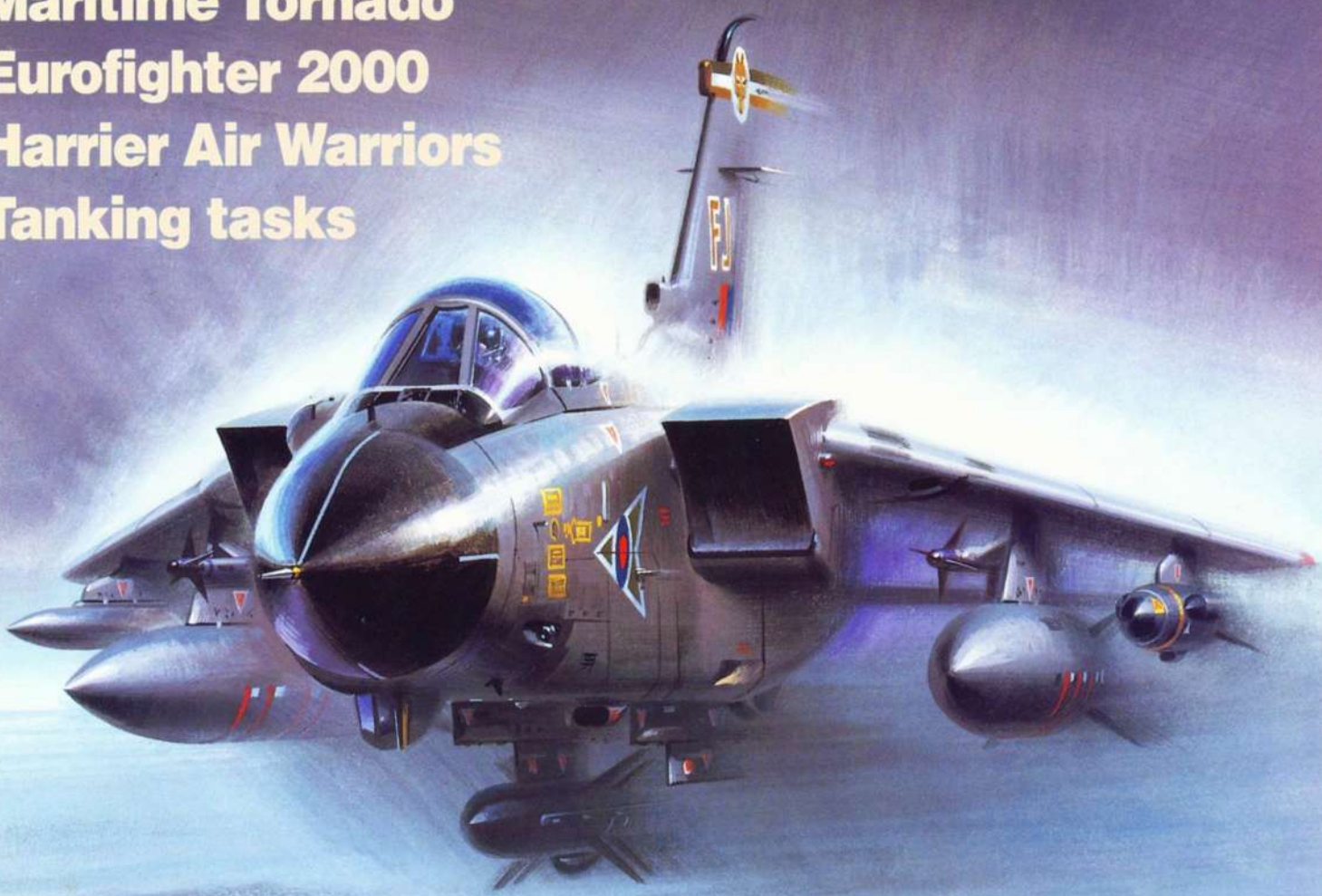

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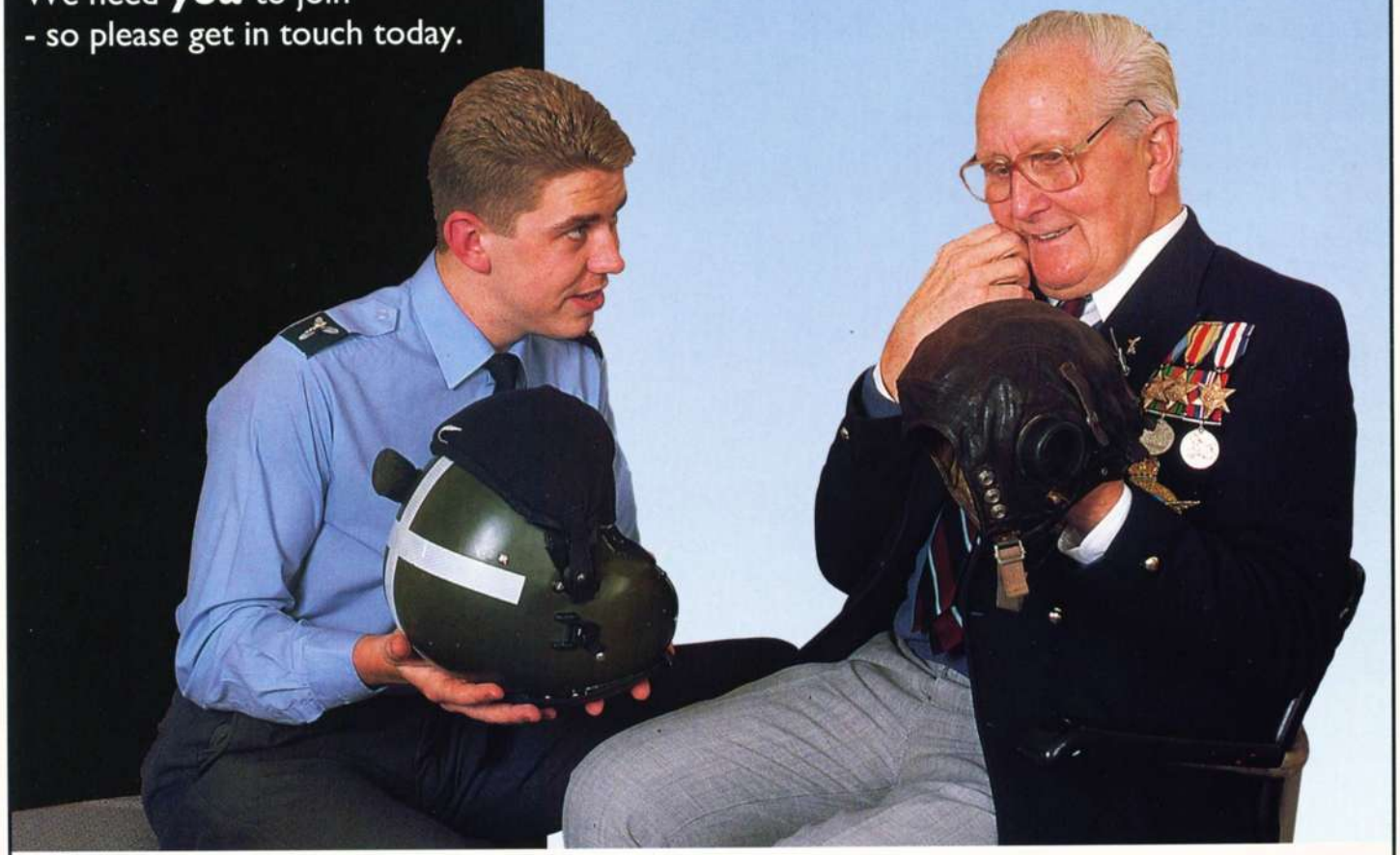

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Royal Air Force YEARBOOK 1995

ROYAL AIR FORCE YEARBOOK 1995

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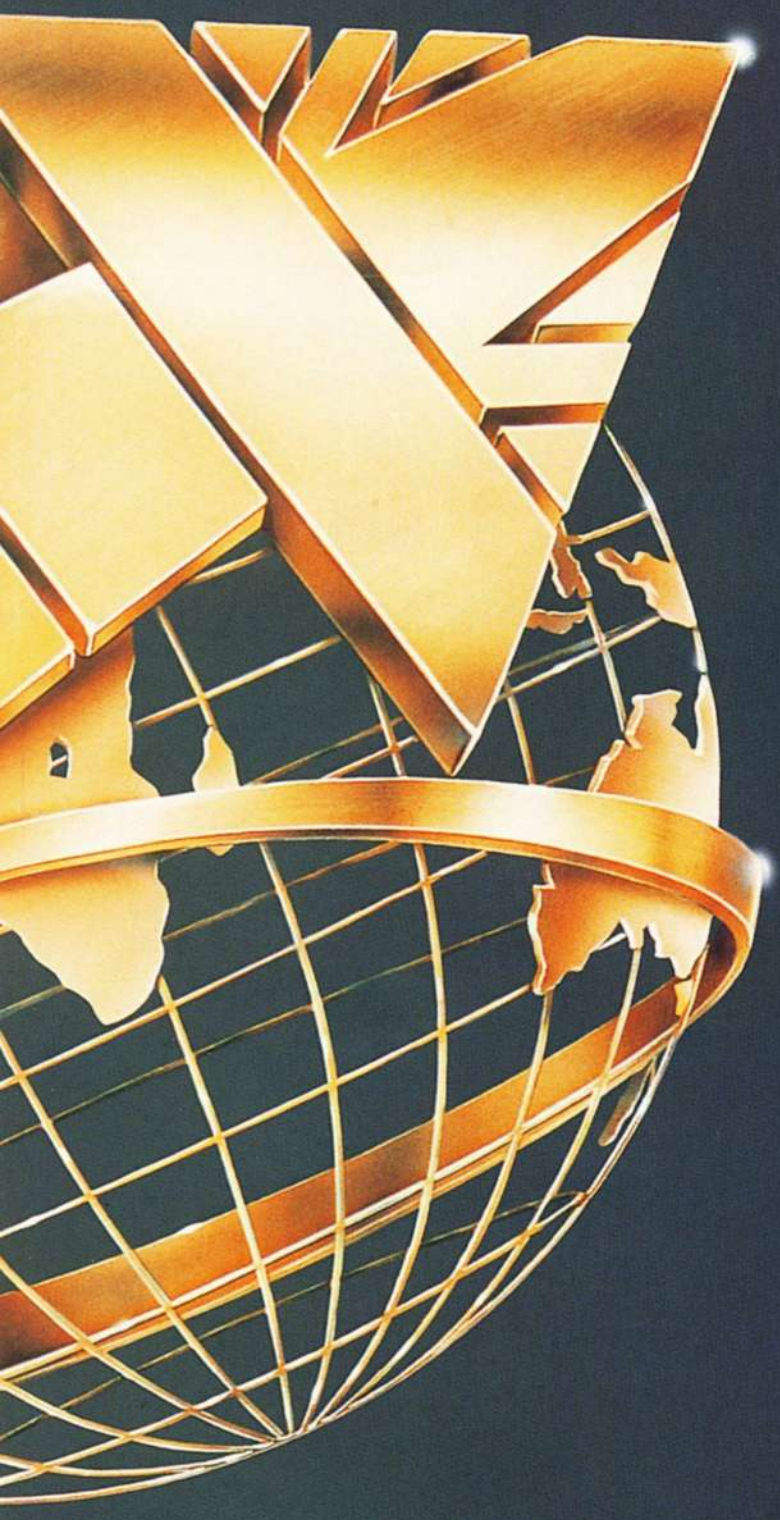
IT ALL POINTS TO GLOBAL CAPABILITY



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Introduction

Air Chief Marshal Sir Michael Graydon
GCB CBE ADC FRAeS RAF
Chief of the Air Staff

This year marks the 50th Anniversary of the end of the Second World War. Throughout the United Kingdom people will be commemorating the beginning of a peace that brought freedom to millions of people all over the world. It is a time to remember the sacrifice and heroism of multitudes of men and women and to reflect on the good fortune that has enabled us in this country to enjoy 50 years without a major war. It is also a time to look forward.

Following the collapse of the Warsaw Pact, the Royal Air Force has been through a period of great upheaval, with much still to take place; but we are now firmly on course to restructure the Royal Air Force to meet the many challenges ahead.

Since the Gulf War, increasingly, the Royal Air Force has been committed to operations throughout the World, on peacekeeping and humanitarian duties. Our aircraft and personnel are deployed in many countries a long way from home with every conventional role of air power providing an essential contribution to the task at hand.

For over 2½ years, Royal Air Force Hercules have flown into Sarajevo, a constant reminder of the daily risks experienced by our people in bringing relief to those caught up in the dreadful bloodshed and suffering in Bosnia. At the same time, we have crews in Italy, Turkey, Saudi Arabia and Bahrain ready to meet any task requested by the United Nations. We have all seen in the past year or so examples of what they can do. Such is the flexibility and speed of air power that we can bring it to bear anywhere in the world at very short notice. And, more and more are we able to provide the precision in attack that is demanded by the nature of today's operations.

But, all of this means that our people are spending a significant portion of each year away on their duties. They know that they are doing a vital job and that each day they could be called upon to go into action over hostile territory. None of us welcomes separation and we are trying to keep it to a minimum but such deployments bring real job satisfaction and valuable operational experience.

Back home in the United Kingdom our units continue to support these operations and to provide a significant contribution to national and NATO security. At the same time we are embarked on the changes arising from the *Front Line First* measures which include painful redundancies from within our workforce. Managing these will be a major challenge over the next few years.

Despite all this, our stations and units continue to work and live as good neighbours within their local community. I am immensely proud of the tireless work our people undertake in support of their local community and of national charities.

As a key part of the Royal Air Force family, the Royal Air Force Benevolent Fund is, understandably, a significant recipient of funds raised. Yet a smaller Air Force will make it more difficult still to look after the many who need our help, such as the survivors of World War 2. A good number are struggling against ill health, bereavement or old age. As we commemorate the end of the Second World War we must also remember that those who served their nation then both deserve and need the help of all of us fortunate enough to have benefitted from 50 years of peace. I ask you to give your support to the Royal Air Force Benevolent Fund today and in the future.

Michael Graydon

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MARITIME TORNADO

Peter R Foster visits No 12 Squadron at RAF Lossiemouth to look at the Squadron's recent transition from the Buccaneer to the Tornado.

After some 14 years of operations overland, the RAF's Tornado GR1 has recently taken on a further demanding task. If results of the first year of maritime operations are anything to go by, this transformation has been a great success. Retirement of the ageing Buccaneer S2B, as the teeth of No 18 (Maritime) Group, was long overdue when the aircraft of No 208 Squadron took their final bow at RAF Lossiemouth on 27 March 1994. Although the Buccaneer did find an essential role in its twilight years, its weapons had become far smarter than the aircraft itself, thus prompting the need for a modern replacement. Arguments will no doubt continue whether the Tornado can accomplish its maritime role better than the Buccaneer. It has to be said that the Buccaneer did have certain items in its cupboard that, taken at face value, did appear more positive. However its airframe was tired and its avionics lacking, even in spite of the FIN 1063 INS update.

Of the final two maritime Buccaneer squadrons (Nos 12 and 208), only the former retains its identity. Its sister squadron was replaced in the role by No 617 Squadron. To achieve the transition to maritime Tornado, airframes were made available by the reduction in Strike Command assets of No 2 Group (formerly RAF Germany), with the withdrawal of Nos 15, 16 and 20 Squadrons as front line units. This was brought about by the reduced east/west tension and effected through the *Options for Change* programme.

The first step in the move saw the two RAF Marham based strike/attack squadrons (Nos 27 and 617) re-equip with recently up-graded Tornado GR1s. These were formerly operated by the Laarbruch wing, having the more powerful RB199 Mk 103 engines – dry rated at 40.5kN (9,104lb st) and 71.5kN (16,073lb st) with afterburning, as opposed to the earlier Mk 101s. These airframes were then further updated to allow operation of the principal anti surface vessel weapon, the BAe Sea Eagle missile and in the process were re-designated Tornado GR1Bs. No 617 Squadron had previously received aircraft modified for TIALD operation, which necessitated a further change as these were transferred to No 14 Squadron, as tasks were re-assigned.

Operating the Tornado in the maritime world is, in many respects, no different from the methods employed by the veteran Buccaneer.

The original plan envisaged re-numbering No 27 Squadron as No 12 (Designate) Squadron, together with a move from RAF Marham to RAF Lossiemouth, and three months overlap period as the Tornado crews worked up for their new role. In the end, however, No 12 (Tornado) Squadron formed on 1 October 1993, the day after No 12 (Buccaneer) Squadron stood down, but the Tornado squadron did not make the move to RAF Lossiemouth until January 1994.

Following the demise of the Buccaneer with No 208 Squadron in March 1994, No 617 Squadron moved from Marham to Lossiemouth on 27 April. This allowed the subsequent move of No 13 Squadron from Honington, with its reconnaissance Tornado GR1As, to take 617's place at Marham. The number plate of the former Buccaneer squadron was transferred to No 4 FTS at Valley, where No 208 (Reserve) Squadron took over from the temporary No 234 (R) Sqn.

Reductions in the RAF's front-line strength through the *Options for Change* policy, was the result of a reduction in the threat following the collapse of the Warsaw Pact and a warming of east/west relations. This has meant that the

Main picture: *No 12 Squadron Tornado GR1Bs have successfully completed their first year of maritime operations.* PRM

RAF can no longer be allowed the 'luxury' of having front-line strike/attack squadrons dedicated to a single task. Thus the RAF's surviving units are taking on even wider commitments than before and are now becoming truly multi-role.

Operating the Tornado in the maritime world is, in many respects, no different from the methods employed by the veteran Buccaneer. The objective is still the same – to adopt and fly tactics that will ensure that a given number of Sea Eagle missiles arrive at the target at the same time.

In daylight and good visibility this is no problem, the launch aircraft can maintain their position relative to each other visually and release their missiles simultaneously. As the light fades and the cloud thickens however, the formation has to get closer and closer until, in thick cloud or at night, they are flying a formation of which the *Red Arrows* would be proud. This is what Buccaneer pilots achieved, but it made for an unwieldy formation and was extremely demanding of the crew. The Tornado, by virtue of its sophisticated navigation equipment, can achieve the same result by navigating independently to a precise launch position at an exact time.

An anti-shipping sortie will start with a tasking signal from the maritime HQ detailing the target task group, its last known position, course and speed, the size of the attacking formation, the time on target and any supporting fighter, tanker, airborne early warning (E-3D Sentry) or maritime patrol (Nimrod) assets. When the task arrives at the squadron a lead crew is assigned, who have to produce a plan which incorporates the available support and includes a weapons delivery tactic suitable for the conditions forecast en-route. Once a plan has been evolved on maps it has to be turned into a format that the computer can understand.

Maps are positioned on the electronic map planning table adjacent to the Cassette Preparation Ground Station (CPGS). With the aid of an electronic cursor, the computer is then aligned by placing the cursor over any two grid intersections and typing in both latitudes and longitudes.

The position of the HAS site and runway thresholds are known and stored in the central memory. These are then fed into the computer and appear as positions 1 through 3. The cursor is placed over each of the turning points in order and these positions are automatically fed into the computer, once again showing up as locations A through W. The target position or positions are then shown as X through Z. In the case of a Sea Eagle profile the launch position would be one of the way-points. When the route has then been finalised, the CPGS computer allows times and speeds to be manipulated. When the navigator is satisfied that the plan is ready, the computer produces not only a hard copy print out but also a cassette containing the same information. This is then loaded into the aircraft's main computer. As a backup, should the tape fail for any reason, the computer can be manually programmed using the information on the hard copy.

The rear cockpit position, which accommodates the navigator, is equipped with two TV-tabs that display a whole range of information from the main computer. This includes data from the Ferranti FIN 1010 digital inertial navigation system (INS) such as the current track against the programmed route, distance from turning points etc, all working from the original plan fed into the onboard computer. A Texas Instruments ground-mapping radar and moving-map display is set between the two TV-tabs and can be selected into a number of modes to suit the operator. The pilot has similar information on his head-up display. The Tornado GR1B is also equipped with a Decca Doppler and laser rangefinder and a marked target seeker in an undernose pod. Setting up the terrain-following radar, which is separate from the ground mapping radar, is carried out by the pilot in the front cockpit.

In the worst case, a night or poor weather attack, the formation of six will transit in three widely separated pairs, each pair trailing the one in front. This so called 'parallel track' formation requires great care in planning to ensure safe separation between aircraft and pairs. Those on the outside of turns must fly faster than aircraft on the inside and under no circumstances must inside and outside

Left: *A VC10 C1K of No 10 Squadron, Brize Norton, provides a necessary top up of fuel during a training flight.* Peter Foster

Below: *The first maritime-grey painted Tornado GR1B received its No 12 Squadron markings in November 1994.* Peter Foster

Above: *Sea Eagle missiles are loaded onto the Tornado's two centreline points.* Peter Foster

Right: *Ready to go, the Tornado GR1B is set to emerge from its hardened aircraft shelter at RAF Lossiemouth.* Peter Foster

aircraft cross over in turns. As they approach the target each aircraft uses the precise nav kit to fly an individual split manoeuvre which puts all six missile launching aircraft at launch range simultaneously, giving them the best chance of saturating a target's defences.

In the days of the Cold War, when the surface threat was considered a distinct possibility, operations would have been carried out as far away from our shores and sea lanes as possible. In such cases the sortie profile would probably have been one of the hi-lo-lo-hi and involve air-to-air refuelling.

The actual attack profile would ideally benefit from assistance from an outside agency, such as a maritime patrol aircraft, which would be shadowing any threat at a discreet distance on radar. This would be in position to provide the complete surface picture or SURPIC. The relevant information would then be passed to the Tornado aircraft flying at wave top height, which in turn would programme the Sea Eagle missile's own onboard computer, in an operation known as *Vector Assisted Attack (VASTAC).*

If such an asset was not available, then one Tornado would climb up and acquire the target on its own radar, then drop back down again. The information gained by this tactic would be added to the missiles own system in the same manner.

The BAe Sea Eagle missile is a 'fire and forget' system achieving high subsonic speeds with a range reported to be in excess of 60 miles. Powered by a Microturbo TRI-60 turbojet giving some 787lb st, it has a high explosive, semi-armour piercing warhead. Once launched from over the horizon, having been programmed by the Tornado crew, the sea-skimming missile flies itself towards the target, the flight path controlled by its own onboard computer. The Sea Eagle pops-up as it nears the computed position, switches on its own radar to acquire the target, before dropping down again to retain the element of surprise.

The missile can be programmed to attack from any selected bearing and is also able to discriminate between several potential targets. Once locked on it is difficult to deceive having a range of sophisticated electronic counter measures and decoys available.

If the target vessel acquires the missile at this particular time, it has little time left in which to adopt counter measures, especially as there could be a number of Sea Eagles (perhaps 12 to 18) bearing down upon it from different angles! If the missile gains this final lock, there is little chance of the target successfully avoiding the inevitable, whilst the Tornado launch aircraft is already well away from the threat area heading home.

Above: *Wings swept, the grey No 12 Squadron Tornado GR1B displays its Sea Eagle missiles.* PRM

Although No 12 Squadron and its sister unit No 617 Squadron are the prime attack assets of No 18 (Maritime) Group, and in turn SACLANT, their role is not limited to over-water operations. The Tornado was designed for interdiction, offensive counter-air, battlefield-air interdiction and precision bombing operations. It can successfully engage in lay down bombing with 1000lb free-fall, or retarded ordnance; loft attacks using the same munitions, and employ a wide range of

Above: *Preparing to descend to its 'working height' at low level, for a training exercise during last November's Joint Maritime Course.* PRM

Above: *Multi-role Tornados of No 12 Squadron – a grey GR1B configured for anti-shipping attack and an as yet unmodified GR1 in grey/green camouflage, with practice bombs.* PRM

weapons including the BL755 cluster bomb, JP233 runway denial weapon and laser guided bombs. All of these were used to great effect attacks over Iraq in the Gulf War.

Ostensibly a maritime unit, No 12 Squadron spends little more than half of its training engaged in such activity, the remaining time is spent preparing for the Tornado's original overland role. It also shares the ever-increasing commitment to a number of NATO and UN operations as part of multi-national peace keeping forces. In some respects it is, along with No 617 Squadron, more heavily tasked than many of its contemporaries.

1994 was a particularly busy year for No 12 Squadron. The move from RAF Marham to RAF Lossiemouth took place during January, whilst the Squadron was mid-way through its maritime work-up phase. This was followed a month later by its first deployment to RAF Gibraltar for ten days to take part in a naval exercise.

March saw many of the crews involved in a ten-day deployment, as part of the tactical leadership training (TLT) programme. Within a week they were departing yet again for a squadron exchange to Istrana in Italy. This two-way exchange visit with 51° Stormo/AMI concluded on 29 March, just before Easter. Soon after, the crews were despatched to CFB Goose Bay in Canada for the standard two-week period of low flying training, which each Tornado squadron undertakes on an annual basis.

The month of May was relatively quiet, by way of preparation for the three months deployment to Saudi Arabia, at the beginning of June, to undertake a stint as part of Operation *Jural*. This time the aircraft remained at Lossiemouth, the crews flying the TIALD capable versions assigned to Dharhan. Upon arrival in theatre the crews qualified, or in some cases requalified, for Thermal Imaging and Laser Designator (TIALD) operations – a task ostensibly assigned to No 14 Squadron at RAF Bruggen but now being shared by all eight Tornado GR1 squadrons.

October saw the Squadron deploy to Nellis AFB, Nevada for a two-week period, participating in one of the highly demanding *Red Flag* exercises. Amid all these deployments, life at Lossiemouth continued with normal training, as well as the usual round of UK exercises, including the four-monthly Joint Maritime Courses (JMC) that are run from Pitreavie Castle. These courses entail both Nos 12 and 617 Squadrons in a very heavy and concentrated commitment over a two-week period.

No 12 Squadron spent almost half of 1994 operating away from its home base – a situation currently mirrored by most other front-line RAF squadrons. This is a problem facing the dwindling number of RAF units that seems little chance of being solved in the foreseeable future. It stands as credit to the Squadron that it fulfils these wide-ranging and very demanding commitments to the highest standards. No 12 Squadron's motto *Leads the Field* is as true now as it was 80 years ago when it was first formed at Netheravon as a multi-role Royal Flying Corps squadron.

WHEN THE BALLOON CAME DOWN

Paul Jackson

Above: *One small step for man. An RAF instructor from No 1 Parachute Training School supervises the departure of an Army paratrooper over Weston-on-the-Green.* All photographs Paul Jackson

Which type of aircraft was in RAF service during World War 2, retired at the end of March this year, and is not preserved by the Battle of Britain Memorial Flight?

If that sounds like a trick question, then it is only because the Balloon Operations Squadron (BOS) at Hullavington slipped below the consciousness level of the aviation enthusiast long before the RAF actually broke with tradition and disbanded its last gas balloon unit. The Airborne Industries Ltd Kite Balloon Mk XIMM proclaims its wartime connections by retention of Roman numerals, but it was performing a useful role until almost the last day before the BOS was stood-down. Big brother of the barrage balloon, the Mk XI has been the platform from which countless thousands of new recruits to the Parachute Regiment have made their first live jump and, thereafter, it has provided the means by which regular and Territorial Army paratroops have conducted half their refresher training.

Overtaken by the drive for economies, the BOS has passed into history after perpetuating maintenance and operating skills developed long before the RAF was formed. Indeed, so taken for granted were its traditional procedures that it was only a couple of years ago that new safety-at-work rules uncovered the fact that the Kite Balloon had never 'been through Boscombe Down'. Accordingly, and with great solemnity, the Mk XI was awarded its Controller of Aircraft type certificate in December 1993, while record-keeping for each envelope was transferred to that hardly new-fangled device, the Form 700. Sadly, in the view of some, the Kite Balloon, having just been brought into the second half of the 20th Century, was destined for early retirement.

Now an army camp with a 'light blue' enclave, Hullavington is a standard, mid-1930s RAF station with a difference. Buildings are to the usual design except that, instead of red brick they are faced with Cotswold stone, producing a unique and most pleasant 'old world' appearance. The BOS was formed as an autonomous unit as recently as 1 April 1993, having previously been part of the Operations Squadron within No 1 Group, whose Parachute Officer doubled as Group Balloon Officer. The BOS badge was granted in May 1954 to the former Balloon Unit, which itself formed at Cardington on 15 April 1948 with the motto, 'In silence we serve'.

Squadron headquarters were in the old Watch Office at Hullavington and its charges were maintained and stored in a small-version (seven-bay, 200ft x 100ft) Type C hangar close-by. Led by Sqn Ldr Christopher R. Pickthall, BOS comprised four officers, nine sergeants and 91 corporals and SACs. Of the last-mentioned, all were MT drivers, including 50 qualified to fly a Kite Balloon after undertaking a four-week course run by the BOS's Training Flight (part of Ops 1). Included in the airmen complement were 14 painters and finishers (Balloon Maintenance) and eight MT technicians.

The sharp(ish) end of BOS was Ops 2: three crews travelling around the country deploying balloons where required by the Army. Each consisted of 15 men (a sergeant, two corporals and 12 SACs) operating in round-the-clock shifts. The vagaries of the British weather demanded a constant presence when out on deployment, in case of a sudden squall threatening the balloon's safety. Careful monitoring of weather forecasts was an essential task for the detachment commander, although the occasional underestimate by the meteorologists produced a few emergency deflations, canopy rippings or even fly-aways resulting from snapped moorings.

During a typical year, the three flights would make a total of some 70 inflations, each lasting between a couple of days and three or four weeks. Hankley Common and Queen's Parade, both in the Aldershot/Farnborough area, were frequently used sites for training the 5th Airborne Brigade, whilst RAF Weston-on-the-Green was the DZ for Brize Norton's No 1 Parachute Training School. Because of its unique parachute training, No 2 Squadron of the RAF Regiment would have the occasional balloon inflated at Watton, a few miles north of its base at RAF Honington. Other locations ranged from disused airfields to public parks. In all, balloons would fly for around 450 days per year and be the platform for some 6,500 jumps during that time.

Old technology

First perfected by Germany for artillery observation, the Kite Balloon has three tailfins to keep it pointing into wind and a maximum fatness ratio of 2½:1 for optimum

Above: *Early start. Dawn is breaking as the 15-man crew lays out a Kite Balloon on a protective tarpaulin base.* Inset: *Immediately prior to take-off, the dispatcher checks the troops' static lines. The Mk 3A car is built of marine ply and weighs 100lb.*

aerodynamic stability. Fins are inflated solely by wind force through a scoop in the leading edge of the lower element, so in still weather they hang limply. With a length of 83ft 6in and maximum width of 33ft 6in, the Mk XI holds 45,000 cu ft of hydrogen. Additionally, the 'ballonet' occupying the whole bottom segment of the envelope contains up to 5,000 cu ft of air which enters via a scoop under the nose. In contrast, a wartime barrage balloon (the L2) was 64ft long and contained 20,000 cu ft of gases.

Weighing 940lb 'empty', the hydrogen-inflated Mk XIMM generated a gross lift of 2,996lb, from which was deducted the weight of a plywood-built Mk 3A balloon car (100lb) and associated rigging to give a net (useful) lift of 1,220lb. This would normally be sufficient for four troops and an instructor, although replenishment was necessary during a prolonged deployment as a consequence of venting.

A 14-inch diameter metal valve in the rear of the envelope limited internal gas pressure by releasing hydrogen as a balloon rose. During descent, the hydrogen mass decreased due to increasing air pressure and the air-filled ballonet expanded, maintaining the shape of the balloon. After a busy day, the cumulative hydrogen loss had to be replaced from an attendant tanker (supplied by Air Products Ltd, in the case of the RAF). A further limitation resulted from air permeating the envelope and mixing with hydrogen. Significant lift is lost with an 8% air content but, more importantly, hydrogen becomes explosive when 20% of air is present. For that reason, man-carrying was terminated when gas drawn daily for analysis through a permanent umbilical cord gave a reading of 92% purity.

Naturally, BOS was assigned the entire RAF stock of up to 30 Mk XI balloons. Contrary to the impression some readers may have gained, these were far newer than their original design and were most certainly not left over from the war. Constructed of rubber-impregnated Egyptian cotton and coated with aluminium spray, a Kite Balloon had a life of only eight years, during which it would be deployed on an average of 25 occasions and flown for a total of 130 days. Thereafter, the fabric would become too porous and the envelope scrapped, requiring replacement at a cost of £90,000. Mk 3A cars, of which four were held at any one time, lasted 10 years before replacement.

Not allocated standard military serials, all the Mk XI balloons were identified by a straightforward numbering system. The most recent batch comprised 338 to 367, which were received between 1 December 1986 and 18 June 1992, at least six of them having succumbed to damage. Typically, a late casualty was 346 which self-deflated when moored at Weston-on-the-Green on 24 July 1994 after weather-forecasters failed to predict 55kt winds. Normal procedure was to deflate on receipt of a 30kt warning, although 20kt was the limit for a normal deflation using the 14-inch valve. Above that, resort had to be made to the emergency ripping panel operated from the ground by a red cord.

Following each deflation, balloons were returned to Hullavington for a major (Check 2) servicing involving 200 man-hours over three days. Taking the danger of residual gas seriously, the hangar was fitted with a lino floor and all lighting was external, shining through the windows to illuminate the interior. After one hour being purged with air, the envelope and all rigging was thoroughly checked, the latter requiring skills closely related to those of a yachtsman.

At the same time, balloon cars received a Check 3. (Check 1, otherwise known as a Primary, was a simple examination of balloons drawn from stock as a reserve but not used.) Following their check, balloons were packed in large canvas bags – an eight-man job – and stored in the corner of a hangar, their 14-inch valves in wooden boxes standing atop the giant bundle. There was no requirement to inflate balloons at Hullavington, although old envelopes were retained as instructional aids, restricted to air inflation only.

Their incongruous hangar companions were 120 items of Russian army equipment: mainly tanks (T62, T72 and T80) but also ZSU-23-4 AA guns, rocket-launchers, armoured personnel carriers, field guns, radars and missiles (AT-5 'Spandrel' and SA-9 'Gaskin'). If all that seems too large to fit in a small Type C, its allocation to the BOS gives a clue. Formerly operated by the Army, this collection of *inflatable* weaponry was allocated to the RAF in view of its greater skill in maintaining such equipment. Transferred to Benson in January of this year, the rubber regiment continues to be used for exercises, forward air controller training and in smaller quantities as backdrops for passing-out parades. Air filled tanks are easy to move about, but at a typical £9,000 for a T72, it might be cheaper to invest in surplus Warsaw Pact vehicles.

Below: *Kite Balloon Mk XI in flying trim, attended by a Clark-Chapman winch. Note air scoops for the ballonet (chin position) and tail fins.*

On the road

Deployment of a kite balloon flight was begun with dispatch of the packed envelope (plus a spare) and its car aboard a winch vehicle. In December 1992, the BOS began changing-over from Rubery-Owen winches aboard Bedford 10-ton trucks to Clark-Chapman hydraulic winches on Ford-Iveco vehicles. The last of 11 new winches was received as recently as mid-1994, when attempts were being made to find possible buyers for the nearly-new equipment.

Balloon inflation took a total of 2½ hours, often in the stillness of early morning. Most of this time was taken up with laying out the envelope on a protective tarpaulin and attaching rigging and the lightning conductor spike, unicorn-like on the 'forehead'. Actual transfer of gas was accomplished in 15-20 minutes, depending on the type of hydrogen tanker used. For this, the envelope was secured to a balloon bed of 12 concrete blocks, transfer to the winch and attachment of the car only being undertaken when parachuting was to begin. At night, balloons were moored 150ft above their bed.

As previously noted, one NCO and four men attended the balloon at all times, working one day on, one off and one on stand-by. The sergeant crew-chief was never completely off duty and was required to be within 15 minutes of the balloon throughout the detachment. His presence was also compulsory during operations, augmenting the two RAF Parachute Jumping Instructors accompanying the soldiers, one DZ Safety Officer and, in the car, one Dispatcher.

Theoretically able to operate at 1,500ft, the Mk XIs normally discharged their human cargoes at 700ft, increasing this to 800ft for a trainee's first jump, or to 1,000ft for self-steering parachutes. During ascent, red-and-white pennants were attached to the cable every 200ft as a visual indication of the correct height. After assessing the situation, the DZSO would signal with flags: red for don't jump; yellow, stand-by; and blue, jump.

Corporal Paul Braithwaite (left) *and SAC Andy Cole test a critical component, the 14-inch valve, for leaks. The valve is mounted above a bag of pressurised air and covered with a layer of water. Note the lino floor and soft shoes.*

The era of signal flags, nautical cable splicings and serene floating has now drawn to a close, it having been decided in 1991 to contractorise army parachute training because of increasing expense. Egyptian cotton is now rare and costly, and synthetic materials generate too much static electricity for a hydrogen balloon. Non-flammable helium would be an alternative (and is used in Belgian-operated Mk XIE balloons) except that it costs six times more than hydrogen, so making regular deflation and movement around the country uneconomical. Furthermore, although there have been no serious accidents, the use of hydrogen sometimes in public parks is viewed with increasing suspicion in a safety-obsessed age.

Bowing to the inevitable, Kite Balloons no longer serve in silence, as they are being replaced by chartered civilian Shorts Skyvans. Compared with the annual cost of £3 million for the BOS, charter will run at about £750,000, making it an irresistible proposition on purely financial grounds.

Some old hands have their doubts. Aircraft jumps, though the norm in sport parachuting, have the added complication of slipstream to disorientate the first-timer while their quick traverse of the DZ gives no time for the nervous to summon their courage for that first step into the unknown. There is something relaxed, gentlemanly – even cold-blooded – about standing on the ledge of the car, trussed-up with parachute and reserve, hearing the instructor gently say, "All right, son, in your own time; you can do it". Buffeted by a gale, near-deafened by two turboprop engines, with someone yelling, "Green on: go, go, go" in your ear, perhaps is not the best way to start a career in military parachuting. However, the bean-counters have spoken and thereby severed the RAF's last link with the genesis of military aviation.

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AIR WARRIOR

Daniel March

At 3.00am the city of Las Vegas, Nevada is finally winding down for the evening, the sun has not yet risen, but eight miles north, at Nellis Air Force Base, the *Air Warrior* day is already under way with early morning briefings for the mock battles taking place 150 miles away at the National Training Centre (NTC) range, Fort Irwin, California.

At the extensive USAF base, known as 'Home of the Fighter Pilot', the RAF has a detachment of ten Harrier GR7s, 20 pilots, 16 other officers and 120 enlisted men and women from Nos 1, 3 and 4 Squadrons. They comprise the first non-US unit invited to participate in this major tactical exercise. The three-weeks detachment, in August 1994, is also the first by the Harrier GR7 to the USA. *Air Warrior* is an Air Combat Command sponsored exercise designed to provide air-land battle training for the US Army within a major force-on-force exercise, thereby giving close air support (CAS) and forward air control (FAC) training for fighter aircrew.

The concept of *Air Warrior* was first announced in 1981 when the US Army began a series of sophisticated, realistic, mock combat exercises at the NTC. It was immediately apparent that a modern large-scale exercise demanded the inclusion of air power. Late in 1981, at the request of the US Army, Tactical Air Command created an eight-man detachment based at Fort Irwin and George Air Force Base, California to initiate USAF involvement in the programme, that was originally named *Coronet Zap*.

Top: *High above the Atlantic, a No 4 Squadron Harrier GR7 takes on fuel from a No 101 Squadron VC10.* All photographs Daniel March

Above: *One of No 4 Squadron's colourful GR7s sizzling in the record high temperatures at Nellis in August 1994.*

Above right: *Wing Commander David Walker, the RAF's detachment commander at* Air Warrior *94-11.*

Right: *The skyscrapers of Las Vegas tower eight miles distant in the shimmering heat behind a No 1 Squadron Harrier taxying in at Nellis.*

Renamed *Air Warrior* in August 1983, this programme has matured through several organisational changes. In 1985 the operation was elevated to squadron status as the 4443rd Tactical Training Squadron and continued to grow both in size and importance. By 1988 the permanent personnel strength had grown from eight to 36 and the number of sorties flown annually from 900 to the current rate of over 4,000.

Nellis AFB became the new home of the ever expanding *Air Warrior* in 1989 due to the closure of George AFB and was integrated into the resident 57th Fighter Weapons Wing. In November 1991 the squadron was redesignated the 549th Joint Training Squadron (JTS), retaining a detachment at the Fort Irwin range. The importance of realistic, in-theatre, training exercises was emphasised during the Gulf War and the value of *Air Warrior* and other such exercises is immeasurable.

It currently provides operational control and logistical support for 36 deployed air units, trains 2,500 personnel and flies over 5,000 hours of joint operations within the NTC each year. *Air Warrior* also trains some 55,000 US Army participants in the application and integration of air power. With approximately 8-10,000 participants actively involved within the NTC during the missions, organisation and planning are vital.

There are two clear objectives for each exercise. The first is to provide support for the air-land battle training within the NTC, using combat air forces and forward air control elements. The second is to provide combat air support training for fighter and FAC aircrew in a realistic, simulated combat environment. Each of the exercises lasts three weeks and the RAF deployment of Harriers, from No 1 Squadron at RAF Wittering and Nos 3 and 4 Squadrons based at RAF Laarbruch, were involved in *Air Warrior 94-11* that took place from 9 - 29 August 1994.

Each *Air Warrior* involves two or three guest units adopting different roles in three distinct elements. The first is 'force-on-force'. This involves each unit aligning with either the opposing (Red) force or friendly (Blue) force to be involved in dynamic and unscripted offensive and defensive scenarios, with live

Top: *1st Air Cavalry AH-64A Apache – the third air component of* Air Warrior *94-11.* Above: *USAF OA-10A taxying out soon after first light to provide FAC for a following pair of RAF Harriers.*

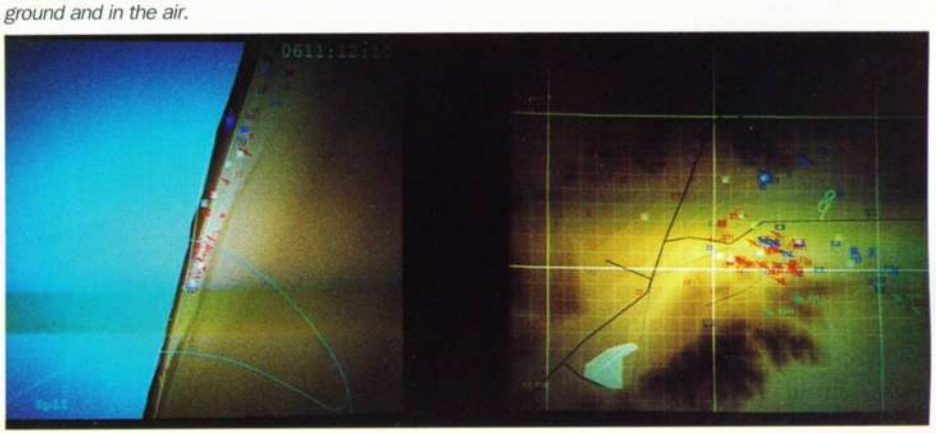
moving targets and visually simulated ground launched weapons. During 94-11 the RAF Harriers provided the Blue force with its air power, while A-10A Thunderbolts from the USAF's 52nd Fighter Wing based at Spangdahlem AB, Germany supported the Red force; OA-10As from the same unit provided FAC for both sides. The third flying unit involved was the US Army's 1st Cavalry with its AH-64A Apaches from Fort Hood, Texas. The Harriers were actually supporting the US Army's 2nd Armoured Division, comprising 5-6,000 men, 250-300 tanks together with some 500 armoured vehicles and artillery pieces. The Red force was represented by the resident army battalion and, although numerically smaller (approximately 3,000 men and 200 tanks), their experience of the exercise and the terrain proved a great advantage in the very competitive battle.

To ensure that the exercise is as realistic as possible the Red force uses simulated Russian equipment, operating procedures and even copy-cat electronic frequencies. Tanks, artillery and helicopters are modified to look and act like their Russian counterparts. The exercise is an unscripted free-fight, with the only restriction being a ceasefire from dusk until dawn. This means that the Harrier aircrew are on duty 10-12 hours a day, ready to respond to demands for an immediate air strike called by the army commanders in the battle areas. Briefings usually begin at 2.45am in readiness for a dawn raid on the opposition, the pilots having no prior idea as to what the mission will entail.

As day breaks the first pair of Harriers are already starting to taxy out carrying their load of 1,000lb dummy bombs, their pilots having just received detailed battle instructions from the range. The FAC aircraft is in place ready to help direct the strike. Some 45 minutes later the Harriers land back at Nellis and the pilots return to the *Air Warrior* Headquarters, for the most valuable part of the exercise, the debrief, which uses the world's first Joint Forces Combat Training Measurement and Debriefing System. This allows real-time evaluation of the effect of close air support on the NTC battlefield, by combining the USAF's Air Combat Manoeuvring Instrumentation (ACMI), as used in *Red Flag* exercises, with the US Army's Instrument Combat Training Centre at Fort Irwin.

The result is a system which is able to display and record 36 aircraft and 700 ground players simultaneously, showing in detail how the battle progresses and the accuracy and influence of the requested air strikes. A pilots

Below: *The key feature of the de-brief is the 'big picture' from the ACMI at Nellis and the ICTC at Fort Irwin, as well as the pilots' eye view, in a real-time replay. Red/Blue force assets are clearly distinguished, on the ground and in the air.*



Left: *All participating aircraft carry the Air Combat Manoeuvring Instrumentation (ACMI) pod – to relay flight details to the numerous recording centres across the ranges, and back to the* Air Warrior *HQ for de-briefing.*

Below: *No 3 Squadron aircraft returning with an empty practice bomb container.*

eye view of the strikes is also possible giving the pilots the capability of reviewing their performance through extensive debriefing, for every mission flown. The realism is emphasised when watching a review of a Harrier pair strike on the opposing Red forces.

The positions of each force component is shown as the Harriers, with call-signs *Spad 11* and *12,* press home their attacks. All of the radio talk between the pilots and the forward air controller is also recorded. As the pilot's trigger is linked to the ACMI system the precise moment of weapon release is observed. *Spad 11* scores a direct hit on a Red target which is immediately shown to be immobilised on the screen, the impact of the bomb being recorded with a spot that marks the demise of a small group of 'hostile' tanks. Meanwhile *Spad 12* narrowly misses a small target surrounded by friendly forces and the call "Smokey SAM" is heard as the pilot spots smoke canisters simulating SAM missiles originating from 'hostile' positions. The ACMI system records the launch of chaff and flares from *Spad 12* and evaluates the chances of his survival in that environment. At the same time the effect of the attacking Red A-10s is also shown on the big play-back screen.

Discussing the value of the RAF's participation as *Air Warrior 94-11* neared its conclusion, the Commanding Officer of the Harrier detachment, Wg Cdr David Walker said that he was particularly impressed with the force-on-force scenario. "We have never trained in an exercise of such a scale, it is a new and very beneficial experience for us. Force-on-force is the best close air support training currently available. Learning to co-operate with our allies, both in the air and on the ground, is vital, as was well illustrated in the Gulf War".

The differences in operational procedure between the RAF and the USAF produced some initial difficulties, as Lt Col Larry A. Lundgren, the USAF's *Air Warrior* Operations Officer, pointed out. "The RAF expects more precise guidance on ground targets. Typically, if there are six enemy tanks, a US pilot will pick one and fire upon it, while an RAF pilot expects the ground troops to select the tank they want targeted".

Wg Cdr Walker also observed: "Close air support, in the opinion of the RAF, is from one mile to as little as half a mile away from ground troops, while the USAF and Army considers, three, four, five or even ten miles away to be sufficient support". The only criticism expressed by the Harrier pilots was the lack of air-to-air threat in the scenario, but as Lt Col Gary L. Buis, the new commander of *Air Warrior* explained: "Air supremacy is presumed, to add an air-to-air element to the scenario is not relevant to the operation, as its primary value is in the training of CAS and co-operation with ground units. Adding an air-to-air threat is far too complicated and would detract from the main objectives". The force-on-force scenario is the 'real meat' of the exercise and after initial procedural difficulties the RAF's Harriers were soon successful in their missions. Towards the end of the exercise the results of the strikes became very impressive. "The learning curve is very steep, we have learnt more in three weeks than in three months of normal training", said Wg Cdr Walker.

The second part of the exercise is the 'Live Fire' scenario. As this title suggests live weapons are carried by the aircraft and used against 2,400 pop-up target silhouettes and numerous static hulk targets (representing MiG-21s, T70 tanks etc). Forward air control is integrated with army live fire, air-launched missiles and bombs. The Harriers mainly operated with 1000lb bombs. The objective of the complex scenario is to create good co-operation with FAC and increase the accuracy of the strikes against very hostile targets. The RAF pilots agreed that the experience of firing live weapons in an environment vastly different from those found in NW Europe is very valuable, given the worldwide locations to which UK forces have found themselves deployed for NATO and UN support and action in the past ten years or so.

The third part of the exercise is the 'Extended Scenario' and involves the use of both live and dummy weapons in a scenario tailored to meet the deployment's particular training objectives. A variety of ordnance was used by the Harriers for different situations including Mk 20, CBU-87, Maverick, 500lb and 1000lb bombs. The Leach Lake area of the range is the setting used exclusively for this final exercise. It is aimed at tightening the procedures for close co-operation between ground control, FAC and the aircraft so that the ordnance is delivered at the correct place, at the exact time requested and in the most effective manner.

After the final battle that had been raging in the mountainous terrain of the NTC had drawn to a close and the last debriefing delivered, the success of the RAF's participation in *Air Warrior* was assessed by Wg Cdr Walker. "It has been a pleasure to be here. The National Training Centre's advantages and uniqueness lies in its vast area and the terrain, which is very similar to global hot spots where we may be faced with war. It has been a tremendous learning experience for us and has proved once again that joint training always pays off".

Despite the mixture of personnel and aircraft from three different squadrons, the Harrier detachment worked very well as a cohesive unit, showing the RAF's ever increasing flexibility and adaptability. The 12-hour working days in temperatures up to 140deg F on the Nellis flight lines were testing conditions for personnel, aircraft and equipment. As Wg Cdr Walker summed up: "The serviceability of the equipment and the high standard that the pilots achieved was a credit to everyone involved in the detachment".

After the unqualified success of this first Harrier detachment to the desert ranges of Nevada and California, it is hoped that the RAF will return to take part in *Air Warrior* again in 1995, this time with Jaguars from the Coltishall Wing.

Before the sun is up, the first RAF Harriers are ready to taxi, with the lights of Las Vegas still dominating the early morning sky.

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Tanking AROUND THE WORLD

Wing Commander Peter Ollis, the Officer Commanding No 101 Squadron, describes a busy period in October last year for the RAF's only dedicated air-to-air refuelling squadron.

Every working day No 101 Squadron launches its VC10 tankers from RAF Brize Norton, its home base, to some of the dozen refuelling areas scattered over the sea off the coast of the United Kingdom. Under the control of the fighter controllers who man the UK air defence radars, they rendezvous at heights around 20,000ft with their pre-booked receiver aircraft. These are predominantly two- or four-ship formations of fast-jet aircraft – Tornados, Jaguars or Harriers – but other frequent users are the larger aircraft of the RAF's fleet such as Nimrods, E-3s, Hercules and other VC10s.

For mixed aircraft formations rigorous procedures are necessary to ensure that the refuelling is conducted in utmost safety and as efficiently as possible. In wartime aircraft are at their most vulnerable when refuelling and so want to spend as little time as possible on the tanker. The receiving aircraft use their own radars, or those of ground stations, to close to within visual range of the VC10. They then join in close formation on the right wing, before being cleared by the tanker pilot to move astern one of the three hoses. Fast-jet aircraft refuel in pairs on the wing hoses, while the large aircraft use the longer, centre-line hose, which also keeps them clear of the VC10's wing-tip vortices. After clearance from the tanker crew, the pilot flies the receiving aircraft to insert its air-to-air refuelling probe into the 'basket' at the end of the VC10's trailing hose, pushing it in until a microswitch is triggered to allow fuel to flow into the receiver's tanks. Typical fuel-flow rates are some 600kg (160gal) per minute – the rates are usually limited by the ability of the receivers to accept fuel, rather than the VC10's dispense rate.

When the receiving aircraft have taken the required amount of fuel, they disconnect from the hose and move to the left wing, from where they are cleared to leave the tanker and continue with their sorties. While this process is continuing – and each tanker might expect to spend two or three hours in the refuelling area – there are frequent requests for fuel from 'bootleggers'. These are aircraft that have not pre-booked a tanker slot, but who want to take advantage of the training situation that has developed while they have been airborne. If the tanker has surplus fuel, and there is often a tonne or two available above the minimum required to return to base, the 'bootlegger' rapidly joins, takes some of this fuel and is quickly back on task with its sortie extended by an hour or so. These routine refuelling missions, known as towlines, take place by day and night. In addition to extending the length and scope of the receivers' sorties, they ensure that RAF pilots maintain their proficiency in the demanding task of air-to-air refuelling – a skill which they will certainly have to use in any conflict, and one which takes time and practice to perfect.

Concurrently with this daily routine around the UK, No 101 Squadron deployed two VC10 tankers to RAF Leuchars in Scotland for a fortnight last October to take part in the Joint Maritime Course. This is one of a series of exercises mounted primarily for the benefit of the Royal Navy and allied navies. In a classic exercise scenario, there are the 'good guys' (the blue forces) and the 'bad guys' (the orange forces). In its usual even-handed manner, the Squadron supports the air elements of both sides. The attacking aircraft comprise Dutch F-16s, German Tornado IDS/ECRs and RAF Tornado GR1/1Bs, with the defending forces operating Tornado F3s and Royal Navy Sea Harriers, as well as NATO and RAF E-3 Sentries.

One of the VC10s launches early each morning at a pre-planned time to provide support for the first incoming wave of attackers, while the other tanker remains at 15 minutes readiness, to scramble with the defending fighters. It is flown to the allocated position where the fighters rendezvous with it in radio silence and replenish their tanks as the aerial dog-fight develops. When the pace slackens, the two tankers meet together, one taking on the other's spare fuel. The full tanker stays on task to top-up the attackers on their return to base, then refuels the fighters to allow them to maintain their combat air patrols, before finally giving fuel to the E-3 Sentry. The other tanker, now with little fuel remaining, returns to RAF Leuchars to be prepared again for flight. Within an hour of landing it is loaded with another 75 tonnes of fuel and is back on 15-min readiness. This busy tanker is soon scrambled again and, with the pair of VC10s swapping fuel between

ALL IN A DA

Harrier GR7 – No 4 Sqn

PRM

Tornado GR1B – No 12 Sqn

PRM

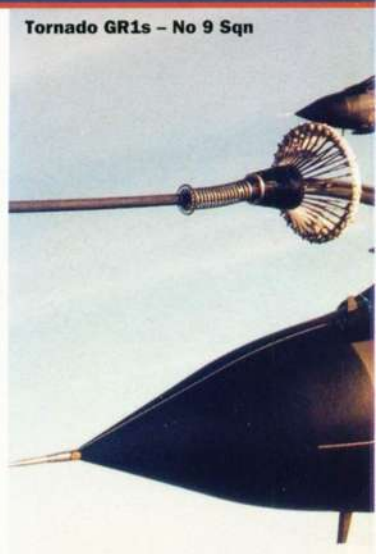
VC10 K4 – No 101 Sqn & Tornado GR1s – No 17 Sqn

Sea Harrier FA2 – 801 Sqn

PRM

VC10 K3 – No 101 Sqn & Sentry AEW1 – No 8 Sqn

Tornado GR1A – No 2 Sqn



Tornado GR1s – No 9 Sqn

PRM

Y'S WORK...

Geoff Whyham

Tornado F3 – No 56 Sqn

PRM

Tornado IDS – MFG-2, German Navy

PRM

Jaguar GR1A – No 54 Sqn

PRM

Tornado GR1 – No 31 Sqn

PRM

Above: *The first grey-painted VC10 K3 (ZA149) with Tornado F3s of No 56(R) Squadron.* PRM

themselves when not refuelling the other exercise players, there is at least one of them on task throughout the hours of the exercise.

At the same time, another No 101 Squadron aircraft is involved in a similar exercise some 7,000 miles away, operating from Paya Lebar airfield in Singapore. It is providing support for RAF Tornado GR1s and F3s, as well as Royal New Zealand Air Force A-4 Skyhawks and Royal Australian Air Force F-18 Hornets for the bi-annual Integrated Air Defence System (IADS) exercise. This demonstrates the ability to defend areas of the Far East as agreed by a five-nation accord. The stage may be considerably different but the role, and the professionalism with which it is conducted, remains the same. No 101 Squadron crews may need to operate in any part of the world at any time, and to refuel aircraft of any nation with whom we are in alliance. It is crucial that every training opportunity is taken, both by the Squadron crews and by those who may need to refuel from them.

At the end of the five-day exercise, a second VC10 from No 101 Squadron lands at Paya Lebar following another exercise in Australia and the Pacific. The two tankers now have to complete the IADS exercise by 'trailing' the RAF fast-jets back to their UK and German bases. On a humid and hazy Singapore morning, the first VC10 leads off its formation of three Tornado F3s and two GR1s, en-route to Columbo International Airport in Sri Lanka, some four hours flying time away. Weaving between towering tropical thunderclouds, the six aircraft join in close formation and route over Indonesia to their first air-to-air refuelling bracket over the Indian Ocean. There are six such brackets on the way across at 20,000ft, each with an abort point. If any of the receivers fails to take on fuel by that position, then that receiver must divert to a pre-determined airfield. Half-an-hour later, the second tanker launches with its similar entourage. The aircraft land at Columbo, providing a fascinating sight to hundreds of locals who surround the airport – they are more used to seeing Airbuses and Boeing 747s than a mixed formation of British military jets.

The next day, 16 hours after landing, the lead tanker is taxying out again with four receivers. Eight Tornados will continue on the planned route to Seeb airfield in Muscat, four with each VC10. There are clear blue skies this time, but there is the added pressure that the diversion airfields, in the event of a failed transfer, are in India, which is in the midst of an outbreak of plague! Happily, the refuelling goes according to plan and the ten aircraft land four hours later, in the balmy Gulf heat. The trail continues with the lead tanker taking the four GR1s to RAF Akrotiri, Cyprus. The next day, the VC10 trails them as far as the French Riviera, giving the GR1s their last fuel top-up, so they are able to reach their base at RAF Brüggen, Germany. This tanker then returns to Palermo, Sicily. By now, the second tanker has deposited four F3s at Akrotiri and is on its way back to pick up the last two F3s. In the last part of the trail, the lead tanker meets the four F3s in Greek airspace and trails them back to the UK. The second tanker collects the remaining pair of fighters and their ground engineers, routing via Palermo to the UK.

As this complex trail passes back and forth through Cyprus, there are two further No 101 Squadron aircraft on duty some 180 miles to the north at the Turkish civil/military airfield at Antalya. This pair of tankers is permanently deployed on Operation *Warden* as part of the United Nations Operation *Provide Comfort*. The RAF provides a force of eight Harriers which fly daily sorties from the Turkish base at Incirlik, supported by these VC10s. Operation *Provide Comfort* was established to police the airspace over northern Iraq following the Gulf War. On each of the sorties, the formation of Harriers joins with one of the VC10s and then refuels before departing for its mission. The tanker loiters in the area; a pair of Harriers then return for a top-up and are quickly followed by a formation of Jaguars from the French Air Force who are also involved in this UN operation. With its own fuel reserves rapidly diminishing, the VC10 calls the USAF E-3 AWACS controller and starts its transit back to Antalya.

Completing this snapshot of No 101 Squadron's many tasks around the world last October, there is one more tanker task to describe. At the USAF's Nellis Air Force Base near Las Vegas, a VC10 has been participating in the *Red Flag* training exercise for the last four weeks. A huge computerised air weapons range has been established in the deserts of Nevada where air forces of many nations come to practise and develop their skills and tactics. The tanker launches to refuel US Navy EA-6B Prowler electronic warfare aircraft and our own Tornado F3s which, as part of the Blue forces, are tasked to act as defenders against the multi-national attackers. The tanker flies two short sorties each day, once again providing a service tailored to the needs of the receiving aircraft.

On each of these detachments and deployments, the aircraft and the aircrew are accompanied by an engineering team. Headed by the 'GE' (ground engineer), a chief technician or a sergeant, there is also one technician from four trades of engines, airframes, avionics and electrics. It is their job to carry out the routine maintenance and to rectify any unserviceabilities which occur while the aircraft is away from its main base. They travel in the small passenger compartment at the front of the aircraft and their work starts when the engines are shut down at the end of each flight. On trails in particular, there is frequently a ground stop of only 14 hours, usually over night. Throughout this period the groundcrew prepare the VC10 for the next leg. While the aircraft may have a comfortable airline style cabin, there are no passengers carried by No 101 Squadron. Down route each member of the groundcrew team is responsible for their trade areas and as such is as important as the aircrew for the successful completion of the trail.

October was a very busy month for the 60 air- and 150 ground-crew of No 101 Squadron. This encapsulates the variety and the worldwide capability of the Squadron's task, combining the operational and tactical flexibility that one normally associates with the fast-jet force, with the more measured but none the less demanding procedural work of the air transport operators. Whenever there is a need to employ airpower in any of its guises throughout the world, the RAF aircraft used to project that power have to be in that operational theatre quickly; almost invariably there will be a No 101 Squadron VC10 tanker in the vanguard.

Below: *No 101 Squadron VC10 K2 with a Harrier GR7, operating in support of Operation* Warden.

EUROFIGHTER 2000

COMBAT FIGHTER FOR THE NEW MILLENNIUM

Main picture: *UK prototype Eurofighter ZH588, first flown in April 1994, seen during its second test flight.* Below: *ZH588 during flight number four.* BAe

Paul Jackson

In 2003, when the world is celebrating the 100th anniversary of the Wrights' canard biplane, the RAF should be feting the service-entry (admittedly only with an OCU) of its first canard fighter. At the acceptance ceremony, it will be a tactless speaker who reminds those present that a quarter of the century since Kitty Hawk has been spent attempting to get the Eurofighter 2000 from the drawing board into RAF service. Such an incredibly long gestation period is, in part, the consequence of ever-increasing combat aircraft sophistication not least the almost total reliance on computers. It is also a reflection of the political procrastination and manoeuvring which is a seemingly inevitable consequence of international military design ventures.

*Some wry amusement may be derived from a reminder that the designations reflected the calendar years in which the aircraft were intended to enter service.

The RAF started out on the protracted road to Eurofighter in May 1979. Until then, the Service had been pursuing Air Staff Target 403 for a V/STOL aircraft to replace both the Jaguar and Harrier. With a satisfactory technical solution unlikely within the timescale set by encroaching Harrier obsolescence, AST 403 was split and a simpler V/STOL requirement drafted as AST 409. That, of course, was satisfied two years later by the McDonnell Douglas/BAe Harrier GR5.

The remaining (Jaguar half) of AST 403 was re-drafted to describe a more agile fighter-bomber with increased emphasis on air defence roles. As such, the aircraft moved significantly closer to the concurrent French ACT-88* and German TKF-90* programmes, so the possibility of a merger was immediately discussed. The resultant TCA (Tactical Combat Aircraft) was conceived under the cloud of inadequate communications, in that the three sets of industrialists, senior officers and politicians were talking to their opposite numbers, but not – in any meaningful way – to each other. TCA progressed as far as being dubbed the 'Eurofighter' before being overtaken by lack of events.

Concerned at the lack of progress, the UK aerospace industry resorted to a now rarely-used measure: the Private Venture. Having launched the P1127 (Harrier) in the face of official indifference, the PV card was played by Panavia companies BAe, MBB (Germany) and Aeritalia (Italy), although acting outside the official Panavia framework. Largely with UK money (also contributed by the leading aircraft equipment firms), BAe Warton's P.110 design was developed as the ACA (Agile Combat Aircraft). In May 1983, this became the EAP (Experimental Aircraft

Programme) when the British Government belatedly put-up part of the funds for a technology demonstrator.

Technology demonstration

On 8 August 1986, EAP ZF534 was first airborne at Warton, quickly achieving qualification to participate in the following month's Farnborough show where it came face-to-face with its Gallic counterpart, the Dassault Rafale. That aircraft, too, had been born out of impatience with the slow process of international agreement. However, a major difference between the two was that the French Government was right behind Dassault and was stalling a pan-European decision by insisting upon a design which bore an uncanny resemblance to the Dassault product in which French firms would have leadership in both design and construction.

Not surprisingly, the UK, Germany, Italy and Spain (which had also joined what was now the European Fighter Aircraft programme) cut France adrift in July 1985 and then made rapid progress towards completing project definition 14 months later. By then, Eurofighter Jagdflugzeug GmbH had formed at Munich, Germany, in June 1986 to manage the EFA airframe design and construction, soon followed by Eurojet Turbo GmbH which would manufacture the powerplant. The definitive European Staff Requirement – Development was issued by the four air forces in September 1987, giving the military specification in more detail, the RAF needs having meanwhile been re-defined as Staff Requirement (Air) 414. Main development contracts for the aircraft and engine were signed on 23 November 1988.

The Eurofighter EFA had the misfortune to be born into the type of world for which NATO had long striven. Dramatic political events were unfolding in the East which were soon to lead to unification of the two Germanies and dissolution of the Warsaw Pact. Now less convinced of the need for EFA to be superior to all-comers, and with pressing economic problems to be overcome in what used to be East Germany, the Bonn government insisted on examining cheaper alternatives to EFA – even off-the-shelf fighters, including the MiG-29 *Fulcrum*.

The EAP technology demonstrator made its public debut at Farnborough in September 1986 (having first flown on 8 August). PRM

EFA marked time throughout 1992, despite the German-built first prototype having been taken by road from Ottobrunn to Manching on 11 May to be prepared for its maiden flight. Fortunately for the survival of the programme, Germany eventually backtracked on most of its objections, apart from cost. At a defence ministers' conference on 10 December 1992, EFA was re-launched and re-named as the Eurofighter 2000 ('EF 2000' for short) to reflect a three-year delay in the first flight of production aircraft to the turn of the century. Germany achieved a 30% price reduction by delaying its own acceptances to 2002 and opting out of some of the specialised items of equipment being developed. Most significantly, Luftwaffe Eurofighters will probably have Hughes AN/APG-65 radar (as in upgraded F-4E Phantoms), instead of the GEC ECR90 specified for the other partners.

First flight

A new European Staff Requirement was issued on 21 January 1994 to define the revised aircraft which, if one is pedantic, is the Eurofighter 2000. Even by then, however, neither the German nor UK-built development aircraft (DA1 and DA2) had flown. Doubts over the integrity of Eurofighter's computer software had demanded a long and painstaking process of verification which kept DA1 (test serial 98+29) languishing at Manching for 22 months before Peter Weger

Right: *The first Eurofighter (DA1) was flown at Manching on 27 March 1994.*

took it aloft on 27 March 1994. The size of the task accomplished beforehand may be judged from the fact that the 'empty' Eurofighter prototypes have nearly ten times the software which will go into the upgraded Tornado GR4.

UK prototype EF 2000 DA2/ZH588 flew on 6 April 1994, but the Italian-built DA3 has suffered similar delays and failed to meet the target of a flight before the end of 1994. DA3 is notable in being the first aircraft of any type powered by a pair of 20,250lb st (90 kN) Eurojet EJ200 reheated turbofans, its predecessors using Tornado-type RB199s for expediency. The remaining four development aircraft are planned to fly during 1995, comprising two-seat DA4/ZH590, DA5/98+30,

Above and left: *Maiden flight of the UK prototype Eurofighter DA2/ZH588 on 6 April 1994.* BAe

Below left: *Touchdown at Warton at the end of a successful first flight.* BAe

the class of a Sukhoi Su-35 *Flanker*, EF 2000 has a higher potential for success than any other aircraft bar the vastly more expensive Lockheed F-22A. That said, it is more potent than the F-22 in ground attack. Its arrival in RAF service is keenly awaited, for Eurofighter will replace Jaguars in the attack role and Tornado F3s for interception.

Until 1991, the Jaguar's home at Coltishall was looking forward to being the first Eurofighter base. The reason for the subsequent change of priorities is not difficult to appreciate when it is recalled that, at the time of writing, Tornados designed to undertake blind interceptions of Soviet bombers over the freezing seas near Iceland, are now attempting to chase Serbian armed-trainers and helicopters around the mountains of Bosnia. Fickle fate, having at last given the RAF a fighter with a decently long pair of legs, has now removed its *raison d'etre*.

It is to interceptor squadrons that the first Eurofighters will go, armed with the standard internal, starboard side, 27mm Mauser gun and up to ten (but usually six/eight) AAMs. Between two and four of these will be the

DA6 (Spanish-built and the second trainer) and DA7, another Italian product.

The seven will conduct a 4,500-hour trials programme to ease the production Eurofighter into service. (EAP, although it did useful work for the programme, flew only 259 times, generating 195hr 21min, up to its final sortie on 1 May 1991.) The first stage in the Eurofighter test-flying schedule was nothing if not brief, for after eight sorties by DA1 and nine by DA2 for a grand total of 15 hours, the two were grounded for refitting until early in 1995. Their consequent absence from Farnborough '94 was rubbed-in by the French, whose Rafale flew daily with the sortie tally – in excess of 2,000 – marked prominently on the fin.

Potent fighter

No higher praise can be given to Eurofighter 2000 than to describe it as a second-best fighter; for such it is. From an evenly-matched start in one-to-one combat at beyond visual range against an adversary in

ROYAL AIR FORCE

Two-seat EF2000 DA4/ZH590 was unveiled at Warton in April 1994, but was not flown during the remainder of the year. BAe

ASRAAMs (Advanced Short Range Air-to-Air Missiles) ordered from BAe in May 1994 and installed on under-wing pylons as a follow-on to the trusty AIM-9 Sidewinder. Semi-recessed beneath the fuselage are four specific positions for a Medium Range AAM of a type still to be decided.

The Future MRAAM, as it is now known, is specified in SR(A) 1239 as a replacement for BAe Sky Flash, and its most important feature will be active radar. Sky Flash homes-in on radar energy reflected from the target by its parent aircraft, so the latter must remain pointed towards the quarry until impact – at times, an uncomfortable restriction. FMRAAM will have its own miniature radar and is thus a fire-and-forget weapon. The choice of AAMs, one of which will be selected in 1996, includes the BAe (international consortium) S225XR and Hughes/Raytheon AIM-120 AMRAAM.

To detect its target, Eurofighter uses ECR 90 radar and/or Eurofirst PIRATE (Passive Infra Red Tracking Equipment) mounted to port of the windscreen. To be installed first on DA5 (although it has been flying in the nose of a BAe One-Eleven since 8 January 1993), ECR90 is a development of the Sea Harrier's *Blue Vixen* with multi-target tracking capability and high resistance to jamming. As the Eurofighter's pilot lacks the valuable services of a WSO/navigator, it is essential for ECR 90 data processing to be rapid and highly automated, with fast changing between modes.

Pilots will be the first in the RAF to have helmet-mounted sights for point-and-shoot launching of missiles at visual targets. Night-capable, the sight will be complemented by the usual HUD, which will be of wide-angle type and additionally will display images from the PIRATE. For such a complex aircraft the cockpit is commendably uncluttered, with only three multi-function screens and one rectangular display panel under the HUD.

It is the purpose of these screens to replace the usual multitude of dials and indicators found in most current RAF aircraft, displaying only that data required for each stage of the sortie. Overriding priority is given to providing the pilot with a clear view of the complete tactical situation, combining inputs from all sensors. At less critical times, the same screens will also show routine check-lists and map displays, including air traffic procedures. Further reducing workload, some non-critical systems, possibly including radio channel and HUD mode selection, will be activated by the pilot's voice.

If the enemy is unsporting enough to shoot back, EF 2000 is well prepared. The EuroDASS consortium is developing a Defensive Aids Sub-System which will comprise radar warning receiver, radar jammer, laser warning, missile approach warning, chaff/flare dispensers and a towed radar decoy. All this is fitted internally, much of it at the wingtips, so there are no add-on pods to take-up useful pylon space. Within the constraints of the design, undisclosed measures have been taken to make Eurofighter as stealthy as possible.

A fighter's fighter

Above all, Eurofighter will be a *fighter*. Emphasis has been placed on low wing loading and high thrust-to-weight ratio for manoeuvrability; good all-round visibility from the cockpit; manoeuvre limits of +9 to -3g; and computer-managed flight controls to ensure 'carefree handling'. The last-mentioned is another way of saying that in air combat, the pilot is not distracted by concerns that he (or maybe, by then, she) might put the aircraft in an aerodynamically untenable position, resulting, for example, in a stall. There is even a 'panic button' which will return the aircraft to straight-and-level flight if the pilot becomes disorientated.

The EF 2000 is both light and strong because of modern techniques of construction. No less than 70% of the surface area is of carbon fibre composites and a further 12% comprises glass reinforced plastic. Metal skinning accounts for just 15%, the major items of which are the foreplanes and outboard flaperons (two-section combined flaps and ailerons along the whole trailing edge).

Great strength is needed here because, in a canard configuration, pitch and roll is imparted by the foreplanes together with both inboard and outboard flaperons. The rudder performs the usual function of yaw control, while leading edge slats made of aluminium-lithium alloy vary the effective camber of the wing to give best performance at all angles of attack. As on the F-16, intakes are located under the fuselage to ensure a supply of air to the engines when flying at a steep angle and low speed. Eurofighter further refines the concept by having hinged bottom lips which are lowered when extra air is required.

In its *alter ego* of fighter-bomber, the EF 2000 has 13 hardpoints for a warload of 14,330lb (6,500 kg), including up to 4,400lb (1,996 kg) of fuel in three external tanks. Internal fuel capacity has not been disclosed, but can be replenished through a retractable probe on the starboard side of the cockpit. The RAF is in the process of acquiring a fresh generation of weapons for both the Tornado GR4 and Eurofighter and these may be presumed to include inertially-guided stand-off munitions dispensers and conventionally-armed stand-off missiles. A decision to phase out the WE177 nuclear weapon will limit the EF 2000's armoury, but a new role could be adopted if the UK goes ahead with an anti-ballistic warhead system involving interceptor missiles launched by aircraft.

Eurofighter is intended to remain in service over a 30-year/6,000 flying hours lifetime, perhaps towards the end of this period, sharing the RAF's front line with a STOL fighter-interdictor developed jointly with the USA. The stated UK requirement is for at least 250 EF 2000s, compared with 120-140 for Germany, 130 for Italy and 87 for Spain. Currently, however, the work sharing agreement provides for the UK to receive only 33% of business, compared with the 43% these figures imply. In the next two years, that will be one of the many outstanding questions which will have to be resolved as Eurofighter transitions from development phase to production.

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Green Blade '94

Patrick Allen describes last autumn's major Support Helicopter Force exercise, the first to involve the new Chinook HC2

Exercise *Green Blade 94*, which took place in southern Scotland and the Border region between 31 October and 11 November 1994, was the largest Support Helicopter Force (SHF) exercise to have taken place since the end of the Gulf Conflict.

The exercise involved over 30 helicopters from all the RAF SHF squadrons within the UK and Germany. It included nine Chinook HC2s from Nos 7, 18 and 27(R) Squadrons; Puma HC1s from Nos 18, 27(R), 33 and 230 Squadrons; Wessex HC2s from Nos 60 and 72 Squadrons plus four Wessex from No 2 Flying Training School (FTS), RAF Shawbury. Nos 7 and 18 Squadrons also brought along their Gazelle HT3s to undertake daylight Night Vision Goggle (NVG) route reconnaissance. Also visiting the exercise was a German Army (HEER) Sikorsky CH-53D together with three Alouette IIIs from No 298 Squadron of the Royal Netherlands Air Force.

RAF fixed-wing involvement included two Hercules from No 47 Squadron that were forward based at West Freugh in Scotland, four Hawk T1As from No 100 Squadron and Tornado GR1As from No 13 Squadron. The Tornados were used for photo-reconnaissance, with the Hawks undertaking fighter evasion sorties against the helicopters. Also involved in the exercise was a No 8 Squadron Sentry AEW1 (with the appropriate call sign *Magic*), which was used to vector the Hawks onto the helicopters, as well as providing a 'Flight Following Service' and 'Airborne Radar Information Service'. This was specifically for the helicopters routing from their flying sites in Galloway to the Forward Operating Bases (FOBs) at Connel Airfield, Oban and Charterhall on the East Coast. Over 2,000 RAF and Army personnel were involved in the exercise, with half supporting the flying side, including some 380 vehicles and 240 trailers all deployed from squadron home bases in the UK, Northern Ireland and Germany. On the night of Tuesday 8 November a total of 1,649 personnel were deployed into the field.

The main purpose of *Green Blade 94* was to deploy forward large numbers of support helicopters into the field. This involved the exercise of both the Command and Control procedures, through the SHF HQ, and the operational capability of helicopters operating from dispersed flying sites. It takes regular

Above: *RAF Chinook HC2s from Nos 7, 18 and 27(R) Sqns line up at RAF Valley prior to deploying into the field in Galloway on Saturday 5 November.* Patrick Allen

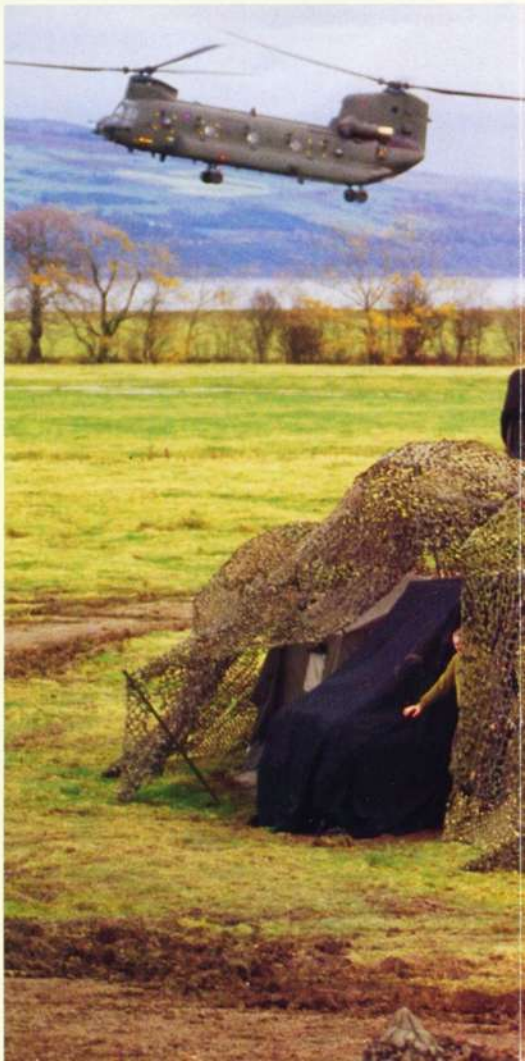
Top: *Four Wessex HC2s of No 60 Squadron depart from RAF Valley for their flying site called* Katmandu *in Galloway.* Above and right: *No 7 Squadron Chinook HC2s during the overwater transit.* Patrick Allen

practice for the aircrew and helicopter maintainers to get accustomed to living and operating effectively out in the field, particularly in poor weather. This exercise provided the SHF with practice in field deployment and establishing and operating from a Main Operating Base (MOB), Forward Operating Bases (FOB) and flying sites. It also gave the opportunity of training in all aspects of tactical flying including Electronic Warfare (EW), Combat Survival and Rescue (CSAR), Escape and Evasion (E&E), Fighter Evasion and Air-to-Ground Gunnery.

The involvement of other elements of 5 Airborne Brigade also gave the SHF HQ the opportunity to work with other command structures such as the Joint Forces Headquarters (JFHQ), 5 Airborne Brigade and 3 Parachute Regiment Tactical Headquarters, all helping to check-out procedures for command and control and tasking etc.

The exercise scenario was a United Nations (UN) approved deployment and intervention by UK Forces, to 'protect and recover British nationals trapped and taken hostage in the fictional former *Republic of Pickhelve* (Scotland)'. There had been ethnic unrest with three main fighting factions of *Grampia* (West Coast of Scotland), *Hadria* (North East region below Edinburgh) and *Galloway* located south of Glasgow. Both *Hadria* and *Grampia* had taken British nationals hostage and undertaken a number of public executions. The main mission was the safe recovery of these expatriots. *Galloway* had offered the use of its military facilities to the UK for any action to help recover their nationals. This would also ensure that Britain would be available to help protect *Galloway*, which was now threatened on two fronts by both *Grampia* and *Hadria*. Continued reports of public executions of British nationals in both *Hadria* and *Grampia* led to a decision to deploy a British rescue force in early November. This involved large numbers of RAF support helicopters, plus elements of 5 Airborne Brigade.

Overnight on Friday 4 November, RAF Valley became a staging post for the UK SHF as it made the deployment to Galloway. Almost all the SHF arrived by last light, with aircrew accommodated in the local gymnasium for their overnight stay. On the morning of the following day, helicopters departed RAF Valley for the overwater crossing, passing close to the Isle of Man, to establish their field flying sites in the exercise area. These were based around the SHF HQ site at Castle Kennedy on the Galloway peninsula with flying sites spread around a 15 mile radius in the Galloway Forest



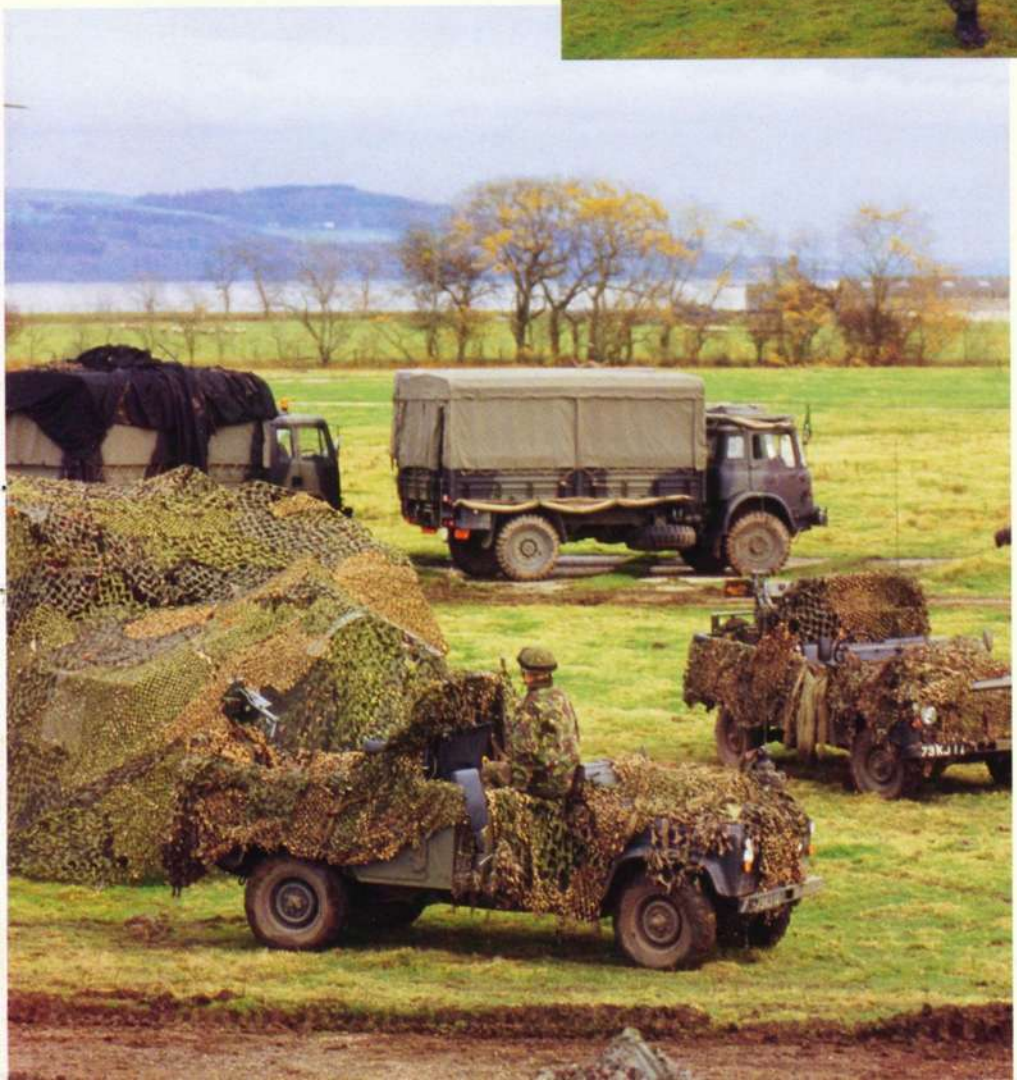
Reconnaissance was provided by Tornado GR1As from No 13 Squadron. PRM

and West Freugh areas.

All these sites had codenames. The SHF HQ at Castle Kennedy was known as *Berlin* and split into four separate sites. *Berlin-Tegel*, with SHFHQ, No 2 Squadron RAF Regt HQ and TCW; *Berlin-Templehof*, a support site housing the Joint Helicopter Support Unit (JHSU); *Berlin-Schonefeld* with EXCON and *Berlin-Gatow* a No 18 Squadron flying site with three Pumas, two Chinooks together with visiting 298 Squadron RNethAF Alouette IIIs and a German Army Sikorsky CH-53D.

The main flying sites were with No 7 Squadron, supplemented by No 27(R) Squadron Chinook HC2 Flight, with three Chinooks based at *Delhi* and four Chinooks at *Saigon*. No 33 Squadron with seven Pumas was at *Venice* and *Cairo*. No 60 Squadron with four Wessex and No 72 Squadron with two Wessex were at *Katmandu*. No 27(R) Squadron with four Pumas, supplemented by two from No 230 Squadron along with the Tactical Support Wing (TSW), were at *Moscow*. The four No 2 FTS Wessex, which were 'enemy' SH-58s, were located at various main sites. The airhead from which the Hercules operated was at West Freugh airfield. Many of the flying sites were supported by 21 Signals Regiment (Air Support) who looked after tactical communications.

Having established a foothold in Galloway, the first operation was to establish Forward Operating Bases in *Grampia* and *Hadria*, which took place on the Sunday evening when Operation *Thunderbird* commenced. The first FOB was established at Connel airfield, just north of Oban, where two No 47 Squadron Hercules para-dropped troops from 3 Para onto the small airfield. No 7 Squadron Chinooks, flying three-ship NVG formations, simultaneously deployed reconnaissance and



Top: *A No 27(R) Sqn Puma HC1 arrives at Delhi to take one of the Chinook crews for a long night of Escape and Evasion (E&E) training at Spadeadam.* Patrick Allen

Above: *RAF Regiment troops para-dropped into the Charterhall FOB. Chinook HC2s pick them up to return them to the Airhead.* Patrick Allen

Left: *No 2 Sqn, RAF Regiment, with its air-dropped Landrovers, undertook perimeter security at the* Delhi *Flying Sites until Nos 7 and 27(R) Sqn Chinooks and aircrew arrived from RAF Valley.* Patrick Allen

screening forces into the area. The second para-jump and FOB was located at the disused airfield at Charterhall near Coldstream, Berwick-upon-Tweed. Both these locations required helicopter support, to both move troops around the operational area and to recover and return hostages and other British nationals. During this operation No 2 Squadron, RAF Regiment, parachuted into theatre to establish and secure the outer perimeter of the FOBs.

The realistic distances involved in this exercise proved invaluable experience for the aircrew, with helicopters having to transit long distances to the operational areas from their flying sites. The realism was also enhanced by routing helicopters through the nearby Spadeadam Electronic Warfare Range. This provided the maximum training benefit for aircrews as they faced numerous Electronic Warfare (EW) threats, requiring the use of their helicopters' Radar Warning

Left: *A 7.62mm six-barrelled MINIGUN was fitted to a No 7 Squadron Chinook HC2 for a static demonstration for the heads of NATO who visited the exercise. The MINIGUN was first fitted during the Gulf War and can fire either 2000 or 4000 rounds per minute.* Patrick Allen

Inset: *No 7 Sqn aircrewman wearing NVGs mans an M60D doorgun. Air to ground gunnery was one of several tactical training exercises which took place during the exercise.* Patrick Allen

Receivers (RWR) and the simulated operation of countermeasures such as Chaff and flares. To make life even more interesting helicopters were also subjected to regular air attack from the Hawks, to help sharpen up their fighter evasion training. The weather, as expected, proved a challenge for most of the week with helicopters needing to route around low cloud and mist as they transited across the higher terrain.

Helicopters operated around the clock with aircrew undertaking numerous night missions with the help of NVGs. All the routes used during the exercise had been carefully planned to give minimum disturbance to the public, with low-level routes planned over unpopulated areas. Initial tasking often lasted up to four hours, with helicopters being re-tasked while on missions. Back at the flying sites heavy rain from the Monday onwards made living and operating at these tented sites a considerable challenge.

A further consideration for aircrew was the knowledge that, on returning to their flying site, a helicopter crew would be 'snatched' for Escape and Evasion training (E&E). Crews would be taken from their helicopters, carrying basically what they had in their pockets (which should, hopefully, have included items needed for survival), and flown out to the Spadeadam ranges. Having received a full brief and been provided with safety equipment, which included a radio and sleeping bag, they were given a map to quickly memorise. Then, without the map, they had to navigate across country to several reporting points (RPs) and then a final Lying-Up-Point (LUP) to await a helicopter CSAR extraction, usually at first light the following day. To make life more interesting and realistic a 'Hunter Force', comprising members of JHSU, were deployed to keep the aircrew on their toes through a long, wet, windy and uncomfortable night.

The exercise proved a great success, with both ground and air-crews receiving valuable training and quickly re-learning the art of field deployments. This was the first major exercise in which large numbers of the RAF's new Chinook HC2s had been field-deployed. The Chinook HC2 exceeded expectations in reliability and availability, with no reported missions aborted due to unserviceability. As expected, the weather proved to be the real enemy, with long periods of heavy rain, together with gale force winds. It is a credit to all the support personnel and aircraft engineers, who lived and operated in some very unpleasant conditions, that the exercise proved such a success. Helicopters and their aircrew remained constantly ready for tasking throughout the exercise.

By Friday 11 November 'all of the British nationals had been rescued from *Grampia* and *Hadria*' and the RAF Support Helicopter Force and other units were able to return to the relative comfort of their home bases.

Latest low-visibility squadron markings on a No 27(R) Squadron Chinook HC2 seen between sorties. Patrick Allen

Probing the atmosphere

Lindsay Peacock investigates the work of the Meteorological Research Flight and its distinctive Hercules W2 *Snoopy*

On the grounds of sheer versatility, there are few aircraft that are able to stand comparison with Lockheed's C-130 Hercules, let alone surpass it when it comes to considering the variety of tasks and missions that have been, and are, undertaken on a routine and not-so-routine basis. Cargo and troop transport; rescue and recovery; satellite capsule retrieval; airborne command and control; pilotless drone operations; intelligence gathering and even bombing figure among those tasks to varying degrees. Its brief also extends to the investigation of weather patterns and phenomena, a task that is performed by the United Kingdom's Meteorological Research Flight (MRF), using the unique Hercules W2 nicknamed *Snoopy*.

Not surprisingly it was the USA that pioneered use of the trusty *Herky-bird* as a tool for gathering data relating to weather. That took place back in the early 1960s, when the US Air Force accepted a quartet of suitably adapted WC-130Bs and assigned them to the Air Weather Service. In fact, there were few clues to differentiate these aircraft from their 'trash-hauling' counterparts of Tactical Air Command and the Military Air Transport Service, apart from the insignia and the presence of a sampling device on the fuselage side.

However, the same claim most definitely cannot be made of a weather-dedicated variant of the C-130 that made its début on this side of the Atlantic Ocean about a decade or so later. The MRF's Hercules W2 is indeed a radically altered machine. Even the most cursory glance at this aircraft will provide confirmation of its change of role. This W2 variant is actually so different from the normal run-of-the-mill Hercules that it more properly merits description as a real 'head-turner'.

The most striking change concerns the large probe that extends forward from the nose. Incorporating highly sensitive instruments used to obtain various types of data, the probe is decorated with red and white stripes to increase its visibility and is somewhat reminiscent of the type of pole that used to be a familiar sight outside of barbers' shops. It is also directly responsible for the aircraft being affectionately known as *Snoopy* – although those who look upon the predictions made by weather forecasters with scepticism might well hold the view that 'Pinocchio' would be a more appropriate name.

Elsewhere on the airframe there are many other sensors: cloud probes, holographic imaging equipment, spectrophotometers, radiometers, hygrometers and sampling pipes are among the array of apparatus used to gather data during the course of flying missions that frequently last up to ten hours at a stretch. They help to make this unique machine one of the world's most sophisticated airborne laboratories.

While the external equipment provides the most visible evidence of change, it is matched by an equally complex suite of internal apparatus located in the aircraft's roomy hold. Like all the best laboratories, the Hercules also has its share of scientists aboard during every sampling flight from its current base at Boscombe Down or elsewhere. They undertake real-time analysis of much of the data that is captured, but the process of study certainly does not end there, since the entire 'take' is turned over to other Meteorological Office scientists for a much more lasting (and infinitely more comfortable) ground-based investigation.

The MRF is, broadly speaking, a joint undertaking, with both of the key contributors being part of the Ministry of Defence. The RAF is responsible for providing the aircraft and aircrew as well as the maintenance support necessary to keep *Snoopy* in an airworthy condition. The other element of the team is the Meteorological Office, which contributes the scientists and has overall control over day-to-

day tasking. In total, just under 50 personnel are currently assigned, comprising half-a-dozen RAF aircrew whose job it is to fly *Snoopy*, with the remainder being civilians from the Meteorological Office. Of the latter, just under half look after essential support facilities such as planning, data processing, liaison and the design, manufacture, calibration and servicing of the airborne instrumentation carried by the W2. The remainder are at the 'sharp end' of the weather research task, for they are all closely involved with the collection and analysis of data. They are fairly evenly divided amongst three specialist groups engaged in the study of cloud physics, radiation and atmospheric chemistry.

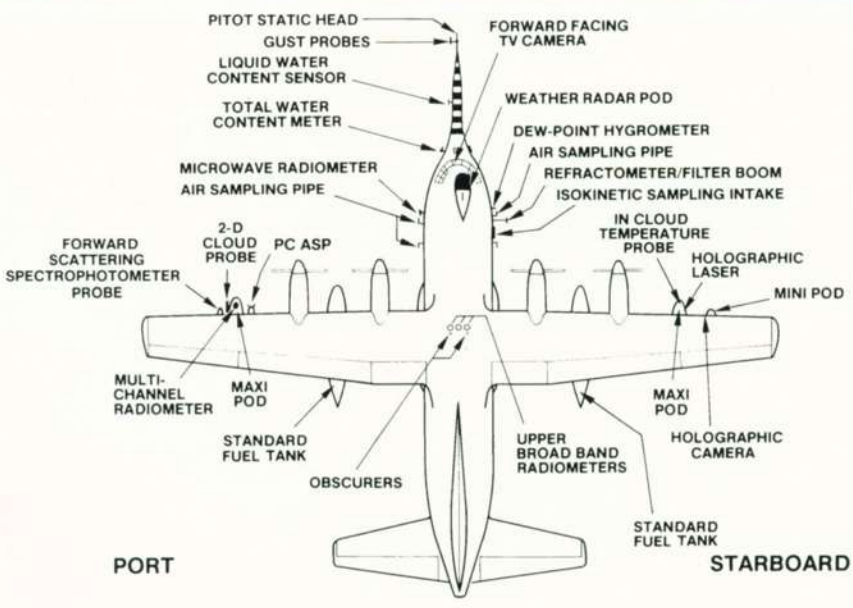
The acquisition of data is not simply a case of getting airborne and flying around endlessly for several hours while the scientists on board take random samples of the atmosphere, although this may be the perception that aircrew who are new to the unit have when they first arrive. It is not a misapprehension they are allowed to labour under for long, since the business of obtaining data actually requires extremely precise flying if the 'take' is to have real scientific and practical value.

The kind of precision flying required is perhaps best illustrated by the fact that some mission profiles are based on

Above: *The large capacity and long endurance of the C-130 make it ideal for atmospheric research.*

Left: *Detailed information on water droplet and ice crystal sizes is monitored by the cloud probe operator seated in the rear cargo hold.*

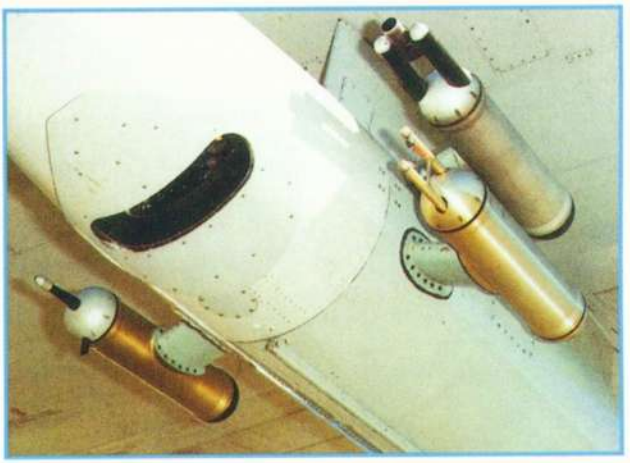
SNOOPY'S METEOROLOGICAL INSTRUMENTATION



variations of as little as plus or minus five feet when flying at 100ft over the ocean. Maintaining the level of concentration necessary to meet that flying accuracy is not easy even for a short period – but some sorties dictate that it be held for as much as two or three hours at a time.

In addition, while overwater flying may not hold out the risk of running into a 'rock-filled cloud', there are still hazards lying in wait for the unwary and unobservant. Shipping, for example, can provide unforgiving obstacles and so can icebergs, which are commonplace in Arctic and Antarctic waters, but which evidently share with the 'stealth fighter' an irritating habit of providing poor radar returns. Of course, there is always the danger of encountering uncharted land in unexpected places, as the current commanding officer of the RAF contingent confirmed when he recalled finding a 'floating' island measuring just a few metres across while operating over the Southern Ocean a good 200 miles from the main Australian land-mass. The island itself was not so much a problem, for it was scarcely a couple of metres high – but the palm tree that was perched on top was a different matter ....

As for what happens to the information gathered by *Snoopy* during its trips aloft, while it is fair to say that increasing effort is now being angled towards finding commercial applications that offer the potential of generating some income to offset the costs involved, the bulk of the work is still devoted to satisfying Meteorological Office requirements. These fall into two main disciplines, with the amount of effort directed to each being roughly even. Both are driven by the desire to obtain a better understanding of just how the earth's



Above left: *On the flight deck: the Aircraft Scientist (far left), in addition to a clear view, has a real-time graphical display of measurements.*

Above right: *A cluster of optical probes mounted under the port wing allows the measurement of cloud droplet, rain drop or ice crystal sizes.*

atmosphere works, although this is actually achieved in different ways.

Computer modelling is one of the methods, with its main concern trying to predict future weather trends using information gathered from the frequent forays by the Hercules W2, as well as a host of other sources. This data is fed into the Bracknell computer centre, where it is employed to refine and improve the programmes used in the modelling process. Since the results can be significantly affected by even the most minor factor, it follows that the modelling is extremely vulnerable to one of the principal drawbacks of computer systems. In simple terms, if you put garbage in, you will get garbage out – and thus the computer's answers are only ever going to be as good as the information at its disposal allows them to be. This again emphasises the need for precision, not only in gathering the data, but also in attempting to determine exactly what that data signifies and the kind of impact it has on weather patterns.

Long-term analysis is the other main strand of Meteorological Office research and is, perhaps, a rather more exact science, since it is concerned with the realities of weather patterns, rather than with attempting to predict them. Nevertheless, despite being a reactive process rather than a proactive one, it is greatly assisted by MRF input.

Snoopy has regularly operated from overseas locations in support of World Meteorological Organisation research programmes. In March 1991, following cessation of the Gulf Conflict, the aircraft made a series of flights through the smoke plume of the burning Kuwaiti oilfields to assess the environmental impact. A more recent deployment was to Queensland, Australia in support of *TOGA COARE* (Tropical Ocean Global Atmosphere-Coupled Ocean Atmospheric Response Experiment), a multi-national research project conducted in the area of the south-west Pacific Ocean.

In recent years, the scope of the work undertaken by the MRF has been significantly broadened in support of other increasingly more sophisticated methods of studying the weather. Nowhere is this more apparent than in the field of utilising satellites to gather data. Barely a decade ago, the contribution made by these costly devices was minimal – now, they are fast becoming an indispensable tool, as well as a cost-effective one, for they have the potential to offer truly global coverage.

However, it is not yet possible to just fire a satellite off into the vastness of space and then sit back to await the stream of information that will be down-linked to receiver stations on earth. That happy state of affairs will eventually be attained, but it will require time and a process that can best be likened to one of calibration. It is in this process that *Snoopy* has been of particular worth, for it permits reliable data to be captured by more traditional means at the same time as the satellite surveys that same area from high above. Study of the results obtained by these separate methods of acquisition allows analysts to make comparisons and build-in any corrective factors that may be found necessary to ensure that the satellite data is accurate – and it is perhaps an unfortunate paradox that using the Hercules W2 in this fashion means that it might well be contributing to its own ultimate redundancy.

For the past 14 years, *Snoopy* has been the only aircraft assigned to the MRF, but it was not always thus, as a brief look at the history of this interesting unit soon confirms. Initially, operational considerations were the

Daniel March

prime motivating factors in bringing about the creation of the MRF, which arose in response to a 1941 requirement to study the influence of atmospheric phenomena on the performance of military aircraft. This essentially involved a 'twin-track' approach, in which the development of improved instrumentation took second place to the need for a solution to the condensation trails that so often betrayed the precise location of Allied aircraft, with deadly consequences for their crews.

As a result, an organisation known as the High Altitude Flight (HAF) was created at the A&AEE Boscombe Down during 1942. This was initially equipped with a couple of Spitfires and a Boston and was largely manned by RAF aircrew, with the Meteorological Office also contributing a scientist. Other aircraft types used during the remainder of WW2 included examples of the Mosquito, Hudson and B-17 Flying Fortress. The unit was never large and might well have anticipated disbandment following the conclusion of that conflict. In the event, the return of peace was not accompanied by the fate of so many front-line echelons that had seen combat action.

Indeed, in the immediate aftermath of the war, the HAF can be said to have prospered. In 1946 it moved to a new home at RAE Farnborough, where it was to remain for almost 50 years. At the same time, the HAF was formally retitled the MRF and it also acquired two examples of the Halifax plus a brace of Mosquitos. These continued to give good service for several years, before they were replaced by more modern equipment early in the 1950s.

First to go was the Halifax, which gave way to another Handley Page product, the Hastings in 1951. The high altitude element received a significant boost with the arrival in 1953 of a Canberra B2 to take over from the Mosquito. As it transpired, in addition to being the only jet-powered aircraft ever assigned to the MRF, the Canberra was also destined to be the longest-serving type to date (1953-81) – as well as being the only known casualty, with B2 WJ582 falling victim to an accident in February 1962. Fortunately, another example in the shape of Canberra PR3 WE173 was soon made available and this remained in service until as recently as 1981.

In the meantime, the MRF received its first Vickers Varsity during 1955, as a replacement for one of the Hastings. This particular aircraft (WJ906) flew with the unit until 1970, when it gave way to WF425. By then, the surviving Hastings was long gone, having been grounded in 1966 and the early part of the 1970s saw the MRF operating a fleet of just two aircraft. One was Canberra WE173 and the other was Varsity WF425, which eventually became one of the last of its type to fly with the RAF, although it fared rather better than most of its contemporaries and passed to the Imperial War Museum at Duxford in 1975 for preservation.

In 1973 a third aircraft was taken on charge, following the completion of an extensive modification programme by Marshall of Cambridge, which culminated in the transformation of a standard RAF C-130K Hercules C1 (XV208) into the unique W2 configuration. Since 1981, this machine has been the MRF's sole aerial platform for the acquisition of weather data, a task that has taken it all over the world and one which has recently come under threat in the light of post-Cold War budget trimming initiatives targeted specifically on the armed forces.

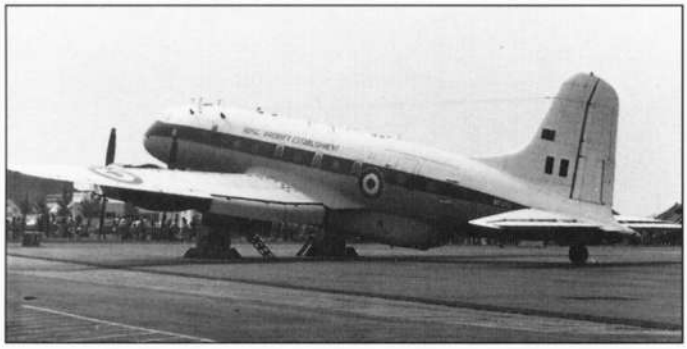
At the present time, *Snoopy's* future is far from assured, although it appears that a proposal to retire the W2 in April 1995 under the 'Front Line First' review will not now be implemented. Naturally, the Meteorological Office and the MRF are delighted by the prospect of an extended life for this valuable research tool, although budgetary restrictions have so far prevented full implementation of a plan to move the entire MRF activity back to its birthplace at Boscombe Down.

As a consequence, although the aircraft and aircrew are now based there, most of the office accommodation, laboratories, technical support facilities and scientific staff remain at Farnborough. That might well be convenient for Bracknell, which is the principal centre of Meteorological Office research, but it does pose its fair share of problems for the smooth running of an operation that is already under pressure.

Furthermore, unless there is a radical re-think, the stay of execution is not likely to allow *Snoopy* to continue in service beyond early 1999, which is when the next major service falls due. Since that service is expected to cost slightly in excess of £1 million, it is clearly an unwelcome obstacle that has to be overcome and might prove to be insurmountable.

In view of that, current planning for research activities is anticipating that the W2 will no longer be available when the next millennium dawns. This is not to say that airborne research will terminate, for the Meteorological Office is anxious to continue making use of aircraft, albeit less than optimistic about finding anything so well suited for the job as the C-130, which marries good altitude, range and endurance characteristics with near ideal cruising speed and handling qualities. At the same time, it is able to carry a worthwhile payload of scientific equipment plus the all-important human operators to manage and monitor the operation of that equipment. As it was said of the Douglas Dakota 30 years ago and is just as true of the Lockheed transport today, the only replacement for the multi-role Hercules – is another multi-role Hercules.

Handley Page Hastings replaced Halifaxes with the Meteorological Research Flight in 1951, serving until 1966. PRM



This Varsity T1 (WF425) flew with the MRF from 1970 until retired to the IWM at Duxford in 1975, where it is now displayed. PRM

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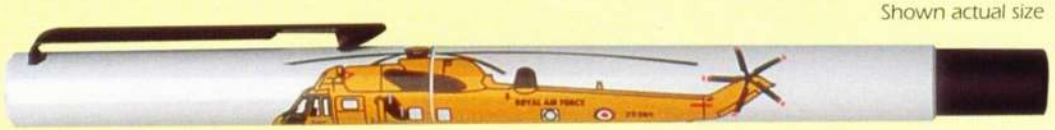

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TOWARDS THE SETTING SUN

Michael J F Bowyer

By 1943 the USAAF in Britain was fast expanding, for the Allies had agreed that the defeat of Germany had first priority. Very gratified with the American contribution to the European conflict the British Government decided to make a much bigger contribution to the Pacific theatre once Italy and Germany were defeated. The British and Allied territories that the Japanese ruled must be liberated and support would simultaneously be given to the Americans.

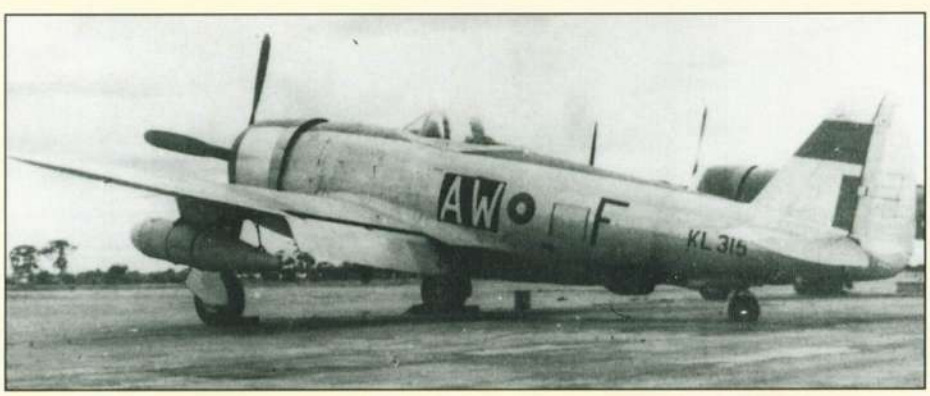
The enormous distances involved generated major logistical problems, making commonality of equipment with the Americans highly desirable. Also clear was the need for ample transport aircraft – long, medium and short range. Because Britain possessed so few, the RAF would have to depend upon American Lend-Lease supplies, leaving the British aircraft industry to prepare combat aircraft specifically custom-built for Air Command South-East Asia (ACSEA).

Britain's main contribution would be a 40-squadron bomber force. Although victory in Europe would release the might of Bomber Command its value would be limited unless the operational range of its Lancasters could be greatly extended. Night operations centring on the strategic bombing of Japanese industry and mounted from island airfields or mainland China would involve very lengthy sorties, packed with potential problems. For that reason each bomber crew would undertake only three sorties per month. The means of extending the Lancaster's range were to be explored, and a new variant was ordered. This was the Mk IV, which became the Lincoln, featuring improved bomb aimers' facilities in a 'universal nose' intended for future bombers. Its increased wing span was introduced to extend the bomber's range.

To reduce operational stress for the crew, the raiders would set out in daylight, meaning that they would need fighter protection. In September 1942 de Havilland had suggested a general-purpose long-range day fighter, powered by two 'Schneiderised' Merlin 61/RM 14 'handed' engines, with ventral ancillary features moved to the engine's rear to reduce the cross section. For this small, four cannon, scaled-down, wooden single-seater, based upon the Mosquito fighter, a top speed of 483 mph at 40,000ft and range of 850 miles at 30,000ft, were forecast. Extended, detachable wing tips and RM 15 engines would be featured for a high-altitude version. By March 1943 a normal range of 1,200 miles, extendable with 50-gal drop tanks to 1,510 miles, looked feasible. Therefore two prototypes were ordered in June 1943 and a contract for 179 DH103 Hornets soon followed. Production of the Mk 1 was planned to commence on 1 January 1945. Its specified performance was a top speed of 480 mph at 22,000ft and a still-air range of 1,100 miles at 20,000ft, with provision for drop tanks to extend it to 1,350 miles. That made the Hornet an ideal escort fighter for a Far East bomber force.

Opting for this fighter raised again the question of how the all-wood aircraft, like the de Havilland Mosquito, would fare in damp, tropical conditions. Trials with two Mosquito IIs suggested all would be well, but in 1944 the glued outer skin panelling to the wing spars in a batch of Mosquito VIs proved troublesome and demanded a different adhesive. That did not discourage another problem – produced when certain termites discovered the taste of Mosquitos much to their liking!

Much needed in India and Burma was close support and fighter protection for the British and Commonwealth armies. In 1943-1944 this was carried out by Hurricane II fighter-bombers, supported by Beaufighters and Vultee Vengeance dive-bombers (replaced in 1944 by Mosquito FB VIs), top cover to which was given in particular by Spitfire VIIIs. The rugged Hurricane, well-suited to rough strip working, was relatively easy to maintain – important, since spares had to be brought over great distances. Good as they were,



Left top: *In natural finish, Thunderbolt II KL315 of No 42 Squadron at Meiktila, Burma, carries wing drop tanks.*

Left: *The fin disc on this olive drab and 'night' Liberator B VI KL629 identifies it as being from No 99 Squadron.*

Left: *NX612, the second production Avro Lancaster B VII (F.E.), wears the white top/black undersurface scheme. Heat reduction was more important than camouflage for the bombers.* (via Bruce Robertson)

Below: *Thunderbolt II* Jungle Queen *of No 134 Squadron, 'bombed-up' in late 1944.*

Above: *Griffon-engined Spitfires entered Far East service late in the war. Depicted are TZ184 (FR XVIII) and NH804 (FR XIV).*

Hurricanes were clearly out-dated by autumn 1943, so AHQ India expressed a wish to replace them, suggesting eight squadrons be re-equipped with Republic P-47 Thunderbolts. The Air Ministry pointed out that the P-47 was a high-altitude long-range fighter, but after US 8th AAF Thunderbolt pilots successfully carried out ground strafing attacks, the British government decided to request Lend-Lease Thunderbolt deliveries. The re-equipment of USAAF Groups with P-51s was beginning, so P-47Ds became available, allowing deliveries direct to India. They started in January 1944 and totalled 780 during that year. By May 1944, when squadrons began using Thunderbolts, delivery of the teardrop canopy version, the Mk II, was already under way. Although the older razor-back variant handled better, the pilot's aft view was poor. Removal of the top rear fuselage unfortunately introduced serious instability problems, reducing the aircraft's aerobatic repertoire, although fitting a fin fillet gave some improvement. Of the 803 Thunderbolts received by the RAF only 378 were Mk 1s and P-47s that served to the end of hostilities were used by 16 RAF ACSEA squadrons.

Most preferred Hurricane replacement was the Hawker Tempest II whose air-cooled radial engine, like the P-47's, was considered less vulnerable to ground fire than a liquid-cooled powerplant. Hawker proposed in late 1939 Hurricane and Typhoon air-cooled engine variants, indeed six examples of the latter powered by 2,000hp Bristol Centaurus radials were ordered in January 1942. Only two were completed because the company was ordered to concentrate on its new 'Typhoon II' project (re-named the Tempest in August 1942) including a Centaurus-powered version. Difficulty with the layout of the exhaust system retarded design work and when test flying commenced excessive vibration and carburation problems above 20,000ft delayed the aircraft's introduction. By VE-Day 50 had been built, and 183 delivered by VJ-Day. With a top speed of 442 mph at 15,100ft and 10,000ft being attained in 2½ minutes, the Tempest II was a nimble performer, but a heavier than expected structure cut the Far East combat radius to 250 miles. It was not until March 1946 that No 5 Squadron at Bophal, India, become the first Tempest operator in SEAC.

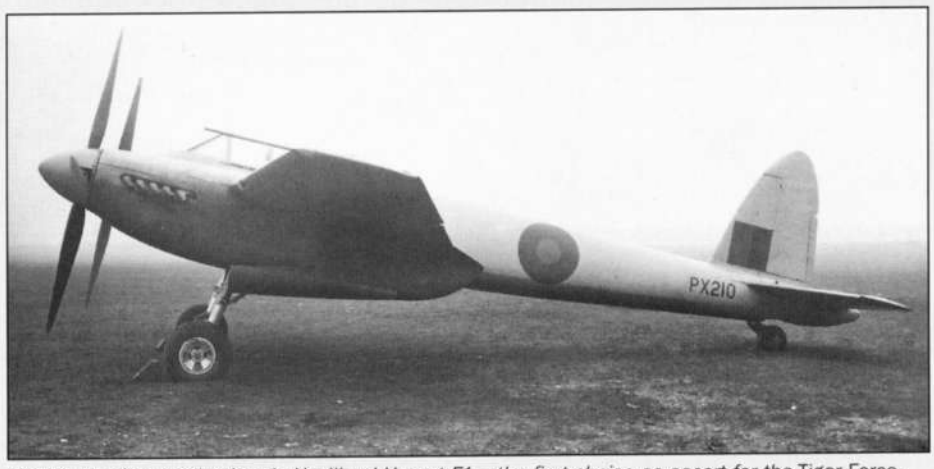
Fighter and fighter-reconnaissance, Griffon-engined, Spitfire XIVs were introduced in the Far East Air Force in March 1945. The Mk 22 was also intended to serve there, as a top cover fighter for the Mk 24 operating in a fighter-bomber role. Not until after the war was either type cleared for service.

Forecasts for production of North American P-51D Mustang IVs in 1945 indicated that the RAF would be able to receive a large number and that many could be shipped directly to South-East Asia for use as long-range bomber protectors, should the Hornet not arrive in time. In the event neither type participated in the fight.

Maritime air operations naturally played a major role in an area dominated by the ocean. The RAF was eager to employ carrier-based Mosquito FBVIs armed with 'Highball', the small 'bouncing' bomb with which No 618 Squadron had hoped to sink the *Tirpitz*. Strong American opposition prevented its use, because of a fear that the Japanese would quickly copy the idea and use it against Allied

shipping. More conventional was a proposed Mosquito VI torpedo-bomber. Although Coastal Command repeatedly requested its development, it met with little success in 1943. A trial installation using an FB VI was successfully tested, but Mosquitos were reckoned to be more useful in other roles.

Instead, reliance was to be placed on the Bristol Beaufighter, developed as a bomber, rocket-launcher and torpedo-bomber, in a version with cropped engine impellers providing maximum power at the very low levels necessary for satisfactory torpedo release. Initially intended as a long duration, cannon-armed, home-defence fighter, its maritime derivative, the Beaufighter TF X, had a combat radius of about 600 miles. This restricted its value for the Pacific war, so Bristol developed a new type, the Brigand torpedo strike fighter version of the Buckingham bomber. Once seen as the much longed for Blenheim replacement, it had proved too large to fulfil the purpose. By 1944 the Buckingham was earmarked for service as a fast transport and, potentially more important, as the overseas replacement for the maritime Wellington. In the Far East the three-seat 38,000lb Brigand TF1 was to be its long-range strike cousin. That was until it was realised that although handling well, the 72ft span aircraft was so large that it would be extremely vulnerable when attacking warships as well as having a poor forward view. In 1946 the Brigand's development policy switched to making it into a 'colonial policing' light bomber. The Buckingham GR2 was abandoned.



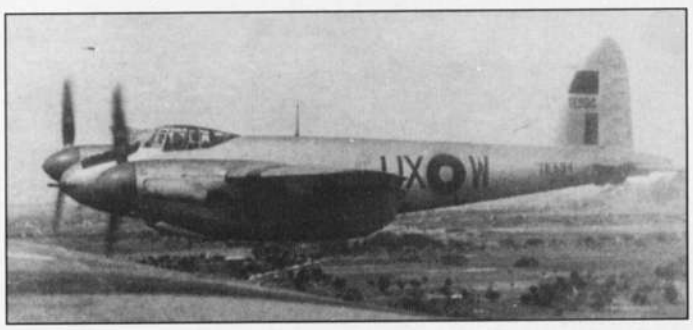
PX210, the first production de Havilland Hornet F1 – the first choice as escort for the Tiger Force.

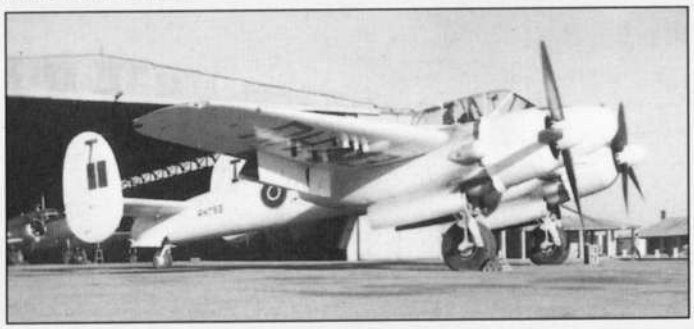
A special aspect of Far East operations was the usefulness of 'behind the lines' operations, with the forays by the Chindits being most spectacular. In an area where the front line was seldom precisely defined, infiltration behind Japanese lines was always feasible. Lysander III (Special Duties) aircraft, a dozen or so Dakotas, a few Halifax VII supply droppers and Catalinas able to alight in coastal waters to put special forces ashore, all played an important part.

Belief that airborne forces, including glider-borne, would be needed to capture Rangoon and Singapore, led to suggestions that Indian Railways' workshops might build Airspeed Horsa and General Aircraft Hamilcar gliders. However, this did not happen, instead large scale deliveries of American Waco CG-4 Hadrians were made. To enable Hamilcar tank-carriers to reach the Theatre, twin Bristol Mercury engines were to be fitted to 75 of them to assist as they were towed overseas by Halifaxes. The war ended before towing started and it also halted an even more bizarre scheme whereby engineless Gloster Meteor fighters were also to be towed overseas!

Among the protectors of vital trade and supply routes in the East were Short Sunderland Mk IIIs. From its introduction the Sunderland III's weakness was seen as its

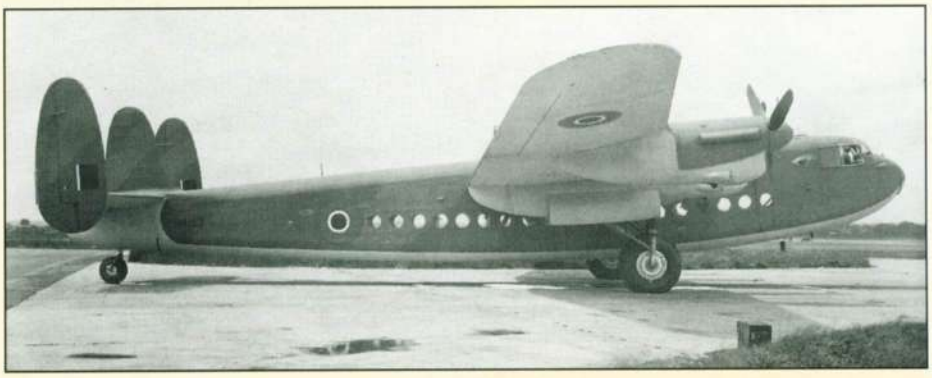
Below left: *Mosquito FB VI TE594 (UX-W) of No 82 Squadron painted silver and carrying black identity bands common in SEAC in 1945.* (via J.D.R.Rawlings) Below right: *RH753 was one of a dozen Brigands that were completed as TF1 strike fighters.* Bottom: *Avro Lincoln B II RE290, wearing Far East colours, was converted to a Mk 1 to hasten powerplant development.* (via Bruce Robertson)





Right: *Devised for long-range air-sea rescue, the Avro Lancaster ASR III (RF310), seen carrying a lifeboat.*

Below right: *Avro York C1 (MW183) of the type which, in 1945, began increasingly to provide RAF Transport Command's long-range trunk route services.*



Pegasus engines, each of which, gave peak performance of 1,000hp at 3,000ft. Although the Sunderland was immensely strong, any additional load naturally forced it lower into the water making handling difficult. More powerful engines able to improve take-off performance were then needed. First the Rolls-Royce Merlin, then in 1942 the Hercules XI and Wright Cyclone GR2600, were considered. Favour switched to the Bristol Hercules VI in a much revised Sunderland IV, which in 1943 was selected for Far East service. A stronger hull and mainplane, wider beam at the chine, longer planing surfaces, increased fuel and a higher engine thrust line, all raised the Sunderland's proposed weight to 71,500lb. Prototype trials at only 55,000lb weight on take-off revealed that even then the aircraft was difficult to handle and very unstable on the climb. Full combat loading would have raised the weight to an unacceptable 75,000lb. Production of the new version, named the Seaford GR1, was therefore abandoned.

Instead, an earlier suggestion for fitting Pratt & Whitney engines to the Sunderland's existing airframe was explored in 1944. It led to the highly successful 60,000lb Sunderland GRV of 1945. With a cruising speed of 150kt at 5,000ft and a range of 2,530 miles, it became the most successful version and gave good service in the Far East. Overwhelmingly though, in 1945, it was the production of a large bomber force for SEAC that seemed paramount.

By August 1944 its composition – 40 squadrons each of 20 bombers with their range increased by 45% allowing operations from Formosa or China – was confirmed. Half the force would undertake daylight, in-flight refuelling (IFR), for which Flight Refuelling at Staverton conducted trials using hoses for fuel transfer. Plans were made to equip one squadron of suitably modified Lancasters for Service trials and training. Production schedules were drawn up to build 600 Lancasters and 600 Lincolns as dual role tankers/receivers. Eight squadrons of Lancasters would, each month, move to Asia – once Germany had been vanquished– and be based two per airfield. By October 1944 a fresh plan called for a strike force of 36 Lancaster or Lincoln squadrons, each 16 aircraft strong. They would be protected by 18 long-range Mustang IV, Mosquito fighter or Hornet squadrons, and placed in three Divisions, each of 12 bomber and six fighter squadrons. By November 1944 it was clear that no Hornets would be available before October 1945 and, pending arrival of the Lancasters, the 1st Division was to operate six Liberator squadrons. Another Division would embrace RCAF squadrons trained in Canada and support would include an air/sea rescue squadron using 10 ASR Lancasters and 10 Catalinas, along with up to three squadrons using Halifax transports. All were part of what was commonly called the *Tiger Force* and officially known as Operation *Tiger*.

There was clearly much to be accomplished. Getting the bombers away for operations on time would be vital, likewise ensuring their safe landings as many would likely have critical fuel states at the end of very long flights. Three fighter squadrons were to share one station, that would be well clear of the bomber bases. Hope was for the first Lancaster III tankers to be ready by February 1945, with Lincoln Is expected to join the force from May 1945 and delivery of the superior re-engined Mk II to start in July 1945. Although production Lincolns began to be delivered in January 1945 none were ready in time for wartime operations.

In November 1944 the provisional layout of post-war Bomber Command was decided. Nos 12, 44, 83, 90. 115, 150, 218, 460, along with RCAF Squadrons Nos 408, 415, 420, 424, 425, 426, 427, 429,432, 433 and reformed Nos 405 and 413 Squadrons would equip an advanced Pacific strike force, whilst Nos 7, 9, 15, 57, 156,97, 101, 166, 467 and 617 Squadrons would be positioned in South-East Asia. All would be arranged in four forces, with Nos 9 and 617 Squadrons equipped with 'Tallboy' bombs, having a special anti-shipping role. No 544 Squadron, using Mosquito 34s and Spitfires, would carry out photo-reconnaissance duties. Much thought was given to boosting the Lancaster III's range to 3,000 miles without IFR – possible by carrying additional fuel in a 'saddle tank' situated above the fuselage. That, permitting the carrying of a 4,000lb bomb load for the stipulated 3,000 miles, caused the IFR scheme to be abandoned, but similar modifications to the Lincoln were not possible. Attempts were also made to increase the range of the Mosquito B35 to 2,800 miles when carrying two 250lb target indicators, to allow 5 Group's No 627 Squadron to undertake low-level target marking.

Throughout the winter ever more detailed planning proceeded, now for a much reduced force of 20 squadrons, each with 20 aircraft. Operational effort was envisaged as 3,360 sorties monthly, requiring 8.4 per aircraft. By March 1945 it was realised that such effort could not be sustained. Using 20 squadrons about 5.7 sorties per aircraft seemed possible. The effectiveness of the Force appeared to increase when the possibility arose of its being based on Okinawa, just 1,000 miles from Japan. That would allow the Lancasters to operate with 10,000lb bomb loads.

Deployment, now intended to start on 15 August 1945, would initially comprise four

AIRCRAFT STOCK – AIR COMMAND SOUTH-EAST ASIA COMMAND 26 July 1945

1) TYPES IN PRODUCTION

Type	*Total in SEAC*	*Grand total on RAF charge*
Auster V	22	436
Beaufighter X	210	827
Dakota IV	337	815
Dominie	15	282
Expeditor II	19	190
Halifax VII(SD)	10	10
Harvard II variants	420	2,127
Horsa	59	774
Liberator B VIII	23	95
Liberator C IX	1	65
Mosquito T III	5	125
Mosquito FB VI	182	1,073
Mosquito NF XIX	36	291*
Mosquito PR 34	10	93
Mustang IV	nil	79
Sea Otter	16	108
Skymaster	4	4
Spitfire PR XIX	10	166
Sunderland V	116	187
Thunderbolt II	287	324
Warwick 1	5	196
York	2	71

1) *also includes NF 36s

2) Grand total of production aircraft held by RAF 26 July 1945 = 20,624

2) EXAMPLES OF TYPES NO LONGER IN PRODUCTION Numbers in ACSEA 26 July 1945

Auster 1 - IV	24
Argus 1-III	84
Cornell	103
Hurricane IIc/IV	435
Liberator B VI	165
Liberator GR V/VI	95 (Mk V - 19)
Liberator VI(SD)	32
Liberator C VII	7
Mosquito PR XVI	40
Oxford	64
Proctor III	13
Vultee L-5 Sentinel	53
Spitfire LF VIII	394
Spitfire FR XIV	49
Spitfire PR XI	40
Warwick C III	9

No 684 Squadron's Mosquito PR XVIs provided photo-reconnaissance cover of Burma, Malaya and Siam. Very long range PR34s joined them just before hostilities ceased.

squadrons of heavies and the Mosquito markers. For a start sea-mining and 'nuisance' anti-morale raids would be undertaken, with Nos 83 and 97 marker Lancaster Squadrons being aided by H2S Mk IV radar. Force expansion would next involve eight squadrons of 5 Group, allowing major incendiary raids led by Mosquito markers using H2S Mk VI.

The *Tiger Force*, formed on 24 February 1945 under Air-Vice Marshal Sir Hugh Pugh Lloyd, was intended to expand into four Wings – Nos 348, 349, 350 and 351 – and fly only Merlin 24 powered Lancaster IIIs and VIIs. All would have strengthened Lincoln-type undercarriages, 8,000lb 'dished' style bomb doors and FN82 rear turrets. All Lancasters delivered from 1 May 1945 would be tropicalised for Tiger Force use and designated B Mk III(F.E) or B Mk VII (F.E.).

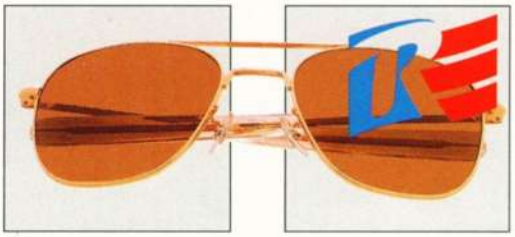
Soon it became apparent that Merlin 24s could not be installed in Lancaster IIIs as it would have entailed installing teleflex outer engine controls, a modification programme entailing 1,000 man hours per aircraft. Instead, the requirement was changed to 200 Mk 1 and 250 Mk VII tropicalised Lancasters.

As soon as the war in Europe ended orders were given for Nos 9 and 617 Squadrons to set sail on 18 August and herald the approach of *The Tigers*. By the time the whole main force was in place it was hoped that bombers would be able to be launched at a rate of one aircraft a minute, allowing 150 to be on their way to Japan in under 75 minutes.

By July 1945, with revised plans showing further Force reductions, current policy was calling for the eventual re-arming to include 11 RAF, six Canadian and one RAAF Lincoln-equipped squadrons. On 20 July the components for Phase One were confirmed as Nos 9 and 617 Squadrons (551 Wing), Nos 106 and 467 Squadrons (No 552 Wing), Nos 83, 97 and 627 Squadrons (553 Wing) and Nos 75 and 207 Squadrons (554 Wing) with Nos 428 and 419 to equip the first Canadian Wing, No 661. Lincoln equipped Nos 431 and 434, 420 and 425, and 405 with 408 Squadrons would follow. A second major transfer of squadrons would occur in October when Nos 44, 57, 207, 460 bomber and 544(PR) Squadrons would proceed east. During August the first Lincolns for the *Tiger Force* joined No 57 Squadron at East Kirkby for intensive flying.

But all the effort, the planning and the preparations were dramatically eclipsed by the dropping of the two atomic bombs which, on 14 August 1945, abruptly brought the end of hostilities undoubtedly saving many lives within the Allied forces. So, instead of setting out for the Far East, the *Tiger Force* spent the middle of August 1945 joyfully celebrating peace. Disbandment came on 31 October by which time it was Transport Command that was the dominant force in SEAC. Good and suitable as they became, many of the aircraft and the crews trained to fly them in the Pacific War in the end took no part in it.



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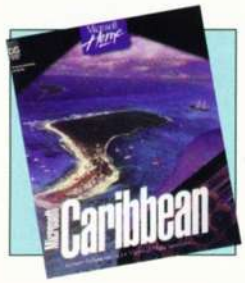






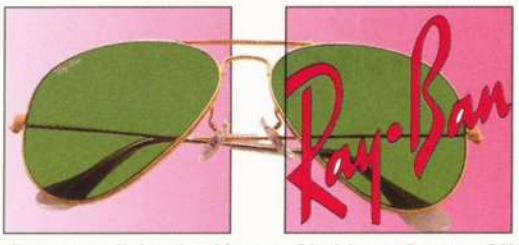


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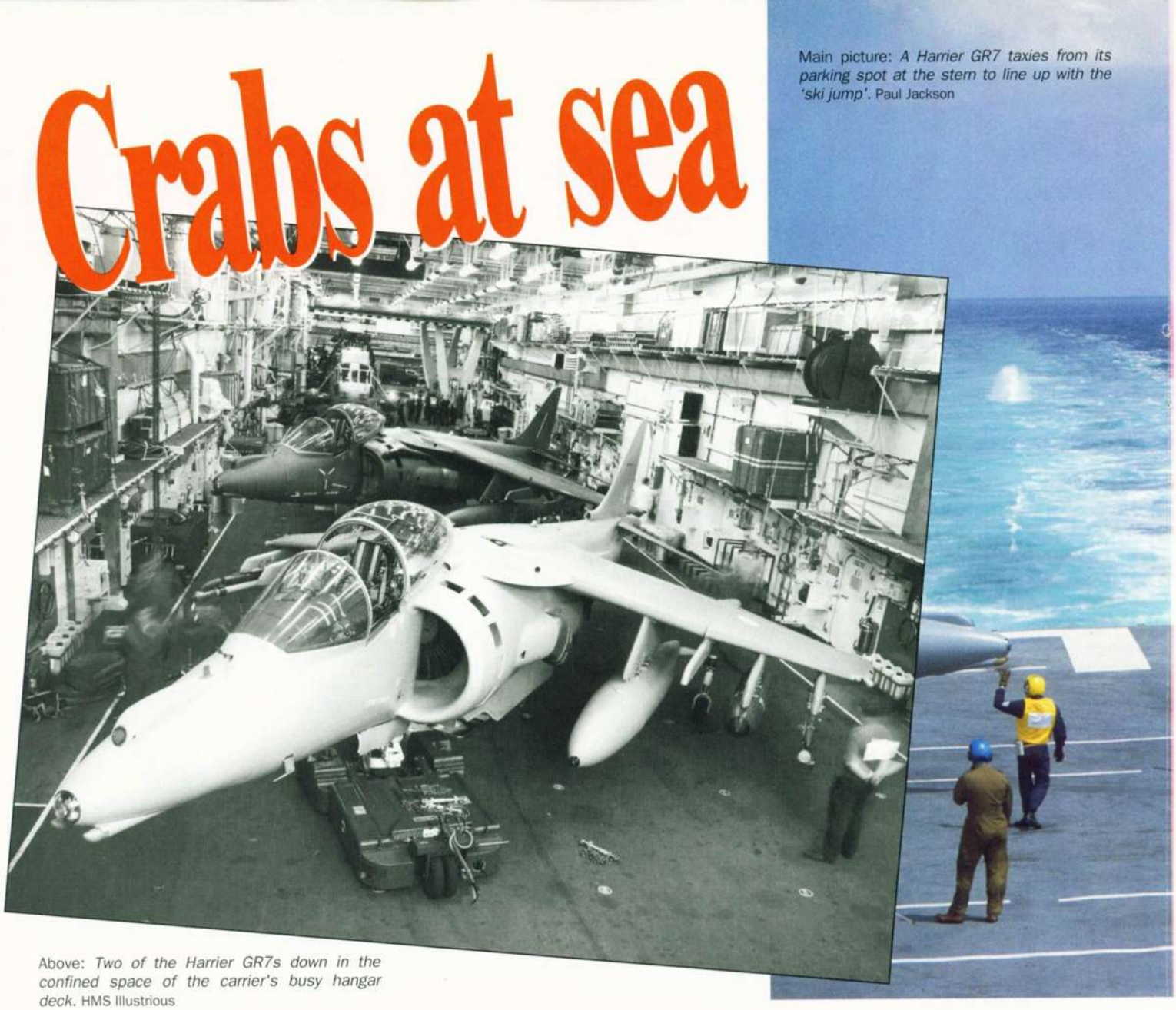
Crabs at sea



Main picture: *A Harrier GR7 taxies from its parking spot at the stern to line up with the 'ski jump'.* Paul Jackson

Above: *Two of the Harrier GR7s down in the confined space of the carrier's busy hangar deck.* HMS Illustrious

Paul Jackson

After a long absence, RAF Harriers again put on their sea boots last summer when the Strike/Attack Operational Evaluation Unit (SAOEU) deployed to HMS *Illustrious* in the South-western Approaches. During three weeks of trials, SAOEU laid the foundations for possible future deployments of RAF Harrier squadrons aboard the Navy's three ASW carriers, *Invincible*, *Illustrious* and *Ark Royal*.

Land-based Harrier GR3s first went to sea during the 1982 Falklands War, when No 1 Squadron was rushed aboard the now decommissioned HMS *Hermes*. It was decided to retain the option of maritime operation and so a further demonstration of the capability was undertaken by the squadron aboard HMS *Invincible* in November 1984 as Exercise *Hardy Crab* –'Crab' being the derogatory term by which the *Fish Heads* refer to RAF personnel.

No 1's maritime commitment lapsed with its conversion to Harrier GR5s from November 1988 and remained dormant when the unit upgraded to GR7s from June 1992. With the Harrier force entirely converted to the night attack version, the time had arrived for exploring maritime operations once again. Notwithstanding the vast experience built-up by the US Marine Corps on the identical AV-8B, Boscombe Down decreed that the GR7's first time at sea should be an experimental operation flown by the SAOEU.

Accordingly, on 20 June 1994 three SAOEU Harrier GR7s and five pilots under their CO, Wg Cdr Nick Slater, took-up station at RNAS Yeovilton to familiarise themselves with the 'ski-jump' used for Sea Harrier training. The aircraft, ZG472, ZG475 (grey overall) and ZG501 'E', had all been fitted with the satellite navigation Global Positioning System (in common with six aircraft of No 1 Squadron). GPS is tied-in with the Ferranti FIN 1075 inertial navigation system, raising its designation to 1075G and the modification can be identified by a 3in white disc antenna on the aircraft's spine.

A base for sea trials was provided by HMS *Illustrious* which had just returned to sea following a major re-work at Devonport. Part of this involved raising the 'ski jump' from 7deg to 13deg to match the other two vessels of the class. *Ark Royal* was built with a 13deg ramp, but the other two have needed retrospective modification. It is unusual to have all three carriers at sea simultaneously, but as only two air groups have been formed, the third deck has no assigned FAA combat aircraft.

Following a week at Yeovilton, the carrier deployment began on 27 June when Flt Lt Chris Norton, flying ZG475, became the first to land an RAF Harrier II aboard ship. The detachment was accompanied by 26 ground engineers and four general duties personnel, although deck handling and other specialist maritime procedures remained in naval hands, for safety reasons. Early work concentrated upon establishing clearance limits and deck interface requirements, testing for electromagnetic interference with the ship's systems and integrating maintenance operations within the confined spaces of the hangar deck.

A further priority was to investigate pre-flight alignment of the Harrier's inertial navigation system (INS) whilst pitching on the ocean, as this had proved to be a major problem during the Falklands War. The FIN 1075G does have the advantage of GPS to tell the inertial system where it is, although the system can still 'topple' if the carrier is manoeuvring hard during the time the INS is winding-up. It was therefore necessary to establish the minimum constraint which has to be placed on the vessel for Harrier GR7 operations.

SAOEU also ensured that the second-generation Harrier was able to use its improved weapon-carrying potential. Take-offs were made at weights up to 6,000 lb more than achieved by Sea Harriers, even under operational conditions. For a launch close to the maximum 31,000lb, the Harrier takes only

Waiting for the order to launch from the carrier, Harriers stand chained to the deck. Paul Jackson

ZG472 leaves the ramp at an air speed of 105kt with bombs and fuel tanks. Paul Jackson

Right: *'It is easier to stop and then land, than to land and then hope to stop.' ZG472 edges along the deck before touching down.* HMS Illustrious

Below right: *Fully laden GR7 launches off HMS* Illustrious' *13deg ski-jump.* HMS Illustrious

two-thirds of the 600ft deck, leaving the ramp at an air speed of 105kt. Taking into account the vessel's progress into wind, that represents a typical ground speed of around 70kt.

In the first week of operations, 21 sorties were flown for a total of 18 hours. Simulated missions were mounted against targets at sea and on land, including some in France. In reciprocation, French Navy F-8E(FN) Crusaders attacked HMS *Illustrious*, with the Harriers then cast in the role of air defence.

Week 2 began with a visit to Landivisiau for a less hectic liaison with the Aeronavale and ended with a return to Boscombe Down on 8 July. In all, the exercise aboard *Illustrious* generated 40 sorties and 44 flying hours. Despite the GR7's nocturnal capabilities, no night missions were flown.

The way has now been prepared for RAF Harriers to return to the sea, possibly in a mixed force including Sea Harrier F/A2s. In an uncertain world, the call to action could be as sudden as that which summoned the Harrier GR3 to the South Atlantic 13 years ago.

THE ARROW OF TIME

What neolithic genius first conceived the idea of the bow and arrow? Or, for that matter, consider the brilliance of that primitive ancestor who first learned to make fire, or flake a stone into a deadly blade. Are we, with our world-altering technology, so much more clever now?

The German philosopher Hegel said, "People and governments never have learned anything from history, or acted on principles deduced from it." Unfortunately it seems Hegel's pessimism has been well-founded. In fact, we have much to learn from history.

Mesolithic Hunters, Valltorta, Spain, 6,000 B.C.

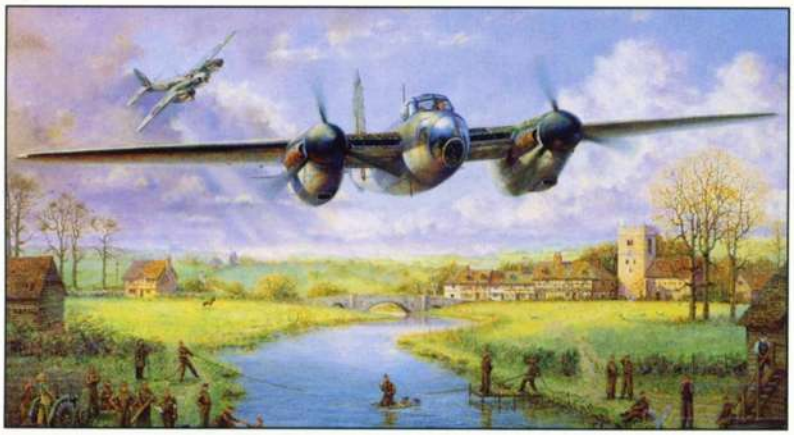
Those people who lived ten thousand years ago, or five thousand, or five hundred, were people like us. The way they confronted the challenges of progress can be very useful to us today. The ancient Britons who built Stonehenge were driven by the same burning need for understanding the order of the universe as we are. The Ming Emperor who chose to stop China's global exploration in the 15th century was compelled by the same political and economic forces that pressure our own leaders to question the space program. The parallels are prolific.

History is like an experiment, endlessly repeated. Reading the results, we can see the advantages that technology has given historical cultures and by comparison, reckon the worth of our own innovation.

The most remarkable impression from reading history is not how much humanity has changed since that first bow was drawn; it is how little. Technology changes, but the nature of people using it does not. Considering all that has happened to technology in the last ten thousand years, the form it will take in the next ten thousand is almost unimaginable. Yet one thing will be constant: If we survive, we will still be the same people.

Lockheed

AVIATION PRINTS BY BILL PERRING



"MOSQUITO!"

Travelling at well over 300 mph, two 139 Sqn. Mosquito crews swoop over the English countryside, utilizing the last few hours of daylight on a winter's afternoon to rehearse the shallow dives and contour hugging runs that will soon be taking them deep into enemy territory - and back again.
On the river below, the Home Guard are also practising, using home-made rafts with varying degrees of success. It is growing colder with the changing weather, but they stick at it - for they too must be ready. Walmington-on-Sea fans will not be disappointed.
Image size 12" x 22" *A Limited Edition of 850*

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Countersigned by 139 Mosquito Sqn. Crew, Sqn. Ldr. Joe Patient. D.F.C. and Flt. Lt. George Cash. D.F.C.

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"FLYING FORTRESS!"

1944. A 91st BG Fortress returns. Losing altitude and with little chance of making it back to Bassingbourn they alter course for the emergency landing strip at Woodbridge. Ten miles south west of Woodbridge lies the tiny waterside hamlet of Pin Mill. Life here is quieter now that many of the evacuees have returned home but there are still the occasional strangers to be seen in the village, driving jeeps, chewing gum and sometimes.....flying aeroplanes.
Image size 12" x 22" *A Limited Edition of 850*

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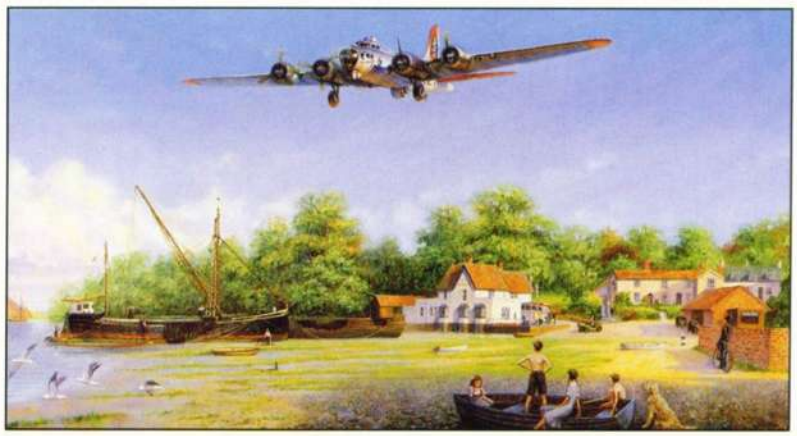

"LANCASTER!"

An early morning in March and a Lancaster returns to an airfield in north-east England. Inside his perspex dome, the mid-upper gunner searches the sky, for although the aircraft is on its final approach, a fighter attack is still possible. On the road below, an Aveling and Porter steam roller is also making its way toward the airfield. Averaging four miles an hour it has travelled overnight to 'do its bit' repairing enemy bomb damage. Only the bargee, it would seem, has had a peaceful night.
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Countersigned by Lanc. Pilot Group Captain Guy Devas. CBE. DFC. AFC. **£40**

Countersigned by entire crew **£65**

SPECIAL PREVIEW "HERCULES!"

The monument and white horse high on a hill above the village of Cherhill are popular landmarks for both balloonists and Hercules crews on their way back to R.A.F. Lyneham a few miles to the north.
This print is due to be published in April '95
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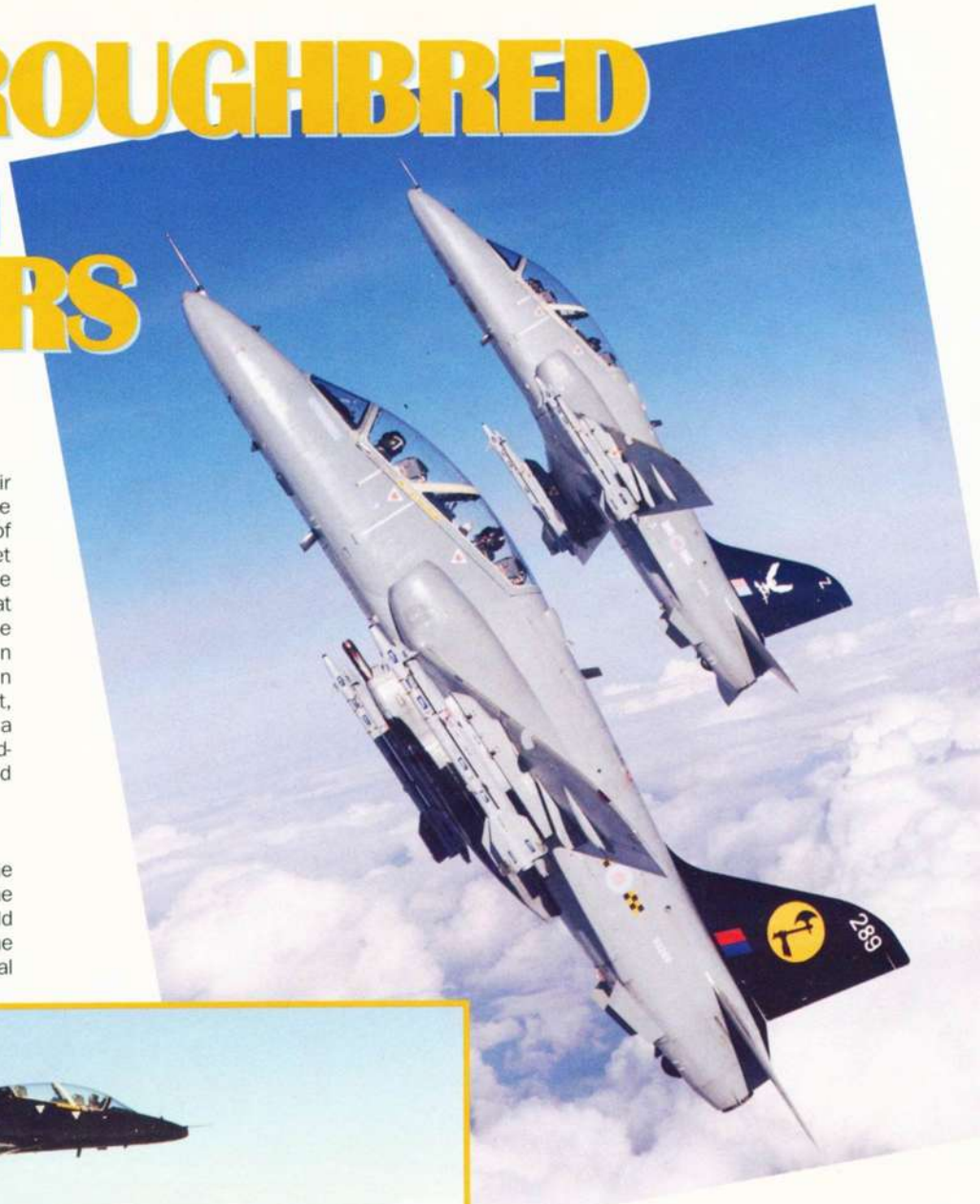
A THOROUGHBRED AMONG TRAINERS



Gordon Bartley

This year, tens of thousands of people at air displays across the United Kingdom, will crane their necks to marvel at the skill and artistry of the RAF Aerobatic Team – *The Red Arrows*. Yet few of them will give a second thought to the Hawk aircraft that they fly, or to the fact that on 21 August 1995, British Aerospace will be celebrating the 21st anniversary of the maiden flight of this thoroughbred among trainers. In the years that have elapsed since that first, tentative flight, the Hawk has evolved from a highly capable advanced jet trainer, into a world-beating light combat aircraft, out-performing and out-selling all other aircraft in its class.

The beginning

In the mid-1960s it was apparent to the Operational Requirements Branch of the Ministry of Defence, that the RAF would require a new advanced jet trainer for the 1970s and beyond, as the operational inadequacies of its existing fleet of Hawker Siddeley Gnat and Hawker Hunter trainers were becoming all too obvious. The HS Gnat, while fast and highly-manoeuvrable, lacked both range and endurance, and was also unable to accommodate taller student pilots. More significantly however, the Gnat was incapable of carrying a realistic weapons load and was even lacking space for an instructor's weapon aiming sight in the rear cockpit. Student pilots were therefore obliged to convert to the Hawker Hunter for their weapons training.

The Hunter too, was not without its problems. A rugged and reliable aircraft, capable of carrying an extensive array of weaponry, it was powered by a Rolls-Royce Avon turbojet engine that had an insatiable thirst for fuel. There was also criticism of its two-seat, side-by-side cockpit layout, which was considered by some, to be wholly unrepresentative of the RAF's current – and projected – front line combat types, all of which featured tandem cockpits.

What the RAF needed was an aircraft that could replace both the Gnat and the Hunter, in the advanced flying and weapons training roles, and which might ultimately take on the basic jet training role of the Jet Provost. Such an aircraft would yield considerable savings in both time and money for the RAF, and would, for the first time, allow students to remain with one type of aircraft throughout their training. There was also a paramount need to reduce development costs of the new aircraft, as UK defence budgets were in steady decline. It was against this background that, in January 1970, Air Staff Target (AST) 397 was issued, calling for a high subsonic speed, basic/advanced jet trainer, to replace the HS Gnat. The British Aircraft Corporation responded with its P59 design, whilst Hawker Siddeley put forward the HS1182.

Above: *Armed Hawk T1As of No 2 Tactical Weapons Unit that was based at RAF Chivenor.* BAe

Left: *Hawk Colours: No 74(R) Sqn – the definitive colour scheme for future Hawks (top); CFS Hawk T1A of No 19(R) Sqn (middle) and the former standard scheme on a No 208(R) Sqn aircraft (bottom).* BAe

Above left: *First flight – the prototype Hawk takes off from Dunsfold on 21 August 1974.* Above: *Air-to-air view taken during the second flight of the prototype.* Inset left: *Duncan Simpson leaves the cockpit after the first flight of XX154.* All Michael Stroud Collection

The BAC P59 was a tandem seat, basic jet trainer, powered by a Rolls-Royce Viper 632 engine and featured a mid-wing installation. The company expended considerable effort to design an aircraft with good all-round performance, a useful weapons carrying capability and, most importantly, docile handling characteristics in critical phases of flight, such as approach and landing.

For its part, Hawker Siddeley had also considered a variety of structural layouts and a wide range of single and twin-engine power installations for the 1182. Ultimately HS settled for a low-wing design, with shoulder-mounted intakes, tandem seating for the crew and a single non-afterburning Adour turbofan engine, for fuel economy. The design promised carefree handling, good all-round performance, a maximum level speed of Mach 0.85 at altitude, together with a realistic weapons load.

After considering both design proposals, the Ministry of Defence announced on 1 October 1971, the selection of HS1182 to meet the requirements of the more definitive Air Staff Requirement (ASR) 397. In March 1972 Hawker Siddeley was able to celebrate the award of a fixed-price contract for 176 aircraft – there being no prototypes as such, with this programme.

Into the air

Hawker Siddeley now began the task of agreeing detailed technical specifications for the new trainer and the construction of a pre-production demonstrator aircraft. It was at this stage that the HS1182 design underwent further radical changes. Firstly, the RAF refused to accept lightweight Folland ejection seats in the new aircraft, opting instead for Martin Baker seats, giving greater commonality with front-line combat aircraft. This resulted in a 10in increase in fuselage length to accommodate the bulkier seats. The RAF also requested the installation of a gas turbine starter to assist with airborne re-lights of the Adour turbofan engine, which was notoriously slow to reach idling speed during attempted re-lights. As a spin-off from this the new trainer would have far greater operational autonomy, with its own inbuilt auxiliary power unit.

A number of structural changes were also made including the repositioning of the main undercarriage oleos, to allow for an unswept rear wing spar. However, the most significant change concerned the air intakes. Wind tunnel tests showed that at speeds above Mach 0.7, the shoulder-mounted intakes of the HS1182 were causing a serious loss of longitudinal stability, as flow separation around the intake structures was effectively blanketing the tailplane surfaces. Hawker Siddeley decided to opt for wing root intakes rather than attempt to solve the 'shoulder problem'.

At the same time, the RAF began its search for a name for the new aircraft. Being a training aircraft, a number of university and traditional scholastic names were considered, but since the new aircraft was also to be marketed by Hawker Siddeley as a light attack aircraft, the name 'Hawk' was eventually recommended. On 3 August 1973 it was officially adopted.

By the spring of 1974, the first Hawk T1 (XX154) was taking shape at the Kingston-upon-Thames factory, utilising assemblies produced at Brough, Hamble and Kingston itself. Its public début was targeted for the Farnborough Air Show in September. In an effort to save time and reduce the workload on the new aircraft, HS took the decision to delay installation of a comprehensive Flight Test Instrumentation (FTI) package in the aircraft, until after the Show. As a result, work on the first aircraft was able to proceed at a much faster rate.

In early summer, major components of the new Hawk aircraft were transferred, under cover of darkness, to the company's test airfield at Dunsfold, where final assembly and initial flight trials were to be carried out. On 12 August, resplendent in the red and white RAF trainer paint scheme, the first Hawk was formally rolled out.

Attention now turned to the Flight Test Department, where Chief Test Pilot, Duncan Simpson and Hawk Project Pilot, Andy Jones, would assume responsibility for testing the new aircraft. With initial engine ground running completed, the first taxi trial – with Duncan Simpson at the controls – was made on 20 August, followed by two further high-speed trials the following day. These trials were used to assess engine and undercarriage responses and to determine control characteristics of the aircraft, up to nosewheel lift-off. Ironically, the only problem encountered was with the nosewheel itself, which refused to castor correctly, when the aircraft was manoeuvred on the ground using differential braking. In spite of this problem, and with the possibility of poor weather on 22 August, Duncan Simpson elected to go for first flight on the evening of 21 August. Unable to manoeuvre effectively on the ground, the Hawk was unceremoniously towed out to the Dunsfold runway and, with all pre-flight checks completed, sped down the runway and was airborne at 1920hr.

That first tentative flight lasted just 53 minutes, during which time the aircraft achieved 325kt IAS and reached an altitude of 20,000ft. Simpson also carried out a limited handling assessment of the aircraft and its systems, including approaches to the stall, both clean and with flaps and undercarriage extended and was suitably impressed with its performance.

Trials and tribulations

The Hawk's first appearance at Farnborough was on 29 August 1974, in readiness for the Press Preview on Sunday 1 September. At this time, just ten flights and a very small part of

Line-up of the first Hawk T1s at RAF Valley in 1977. Michael Stroud Collection

Top: *No 100 Squadron Hawk T1A.* BAe Inset left: *The* Red Arrows' *Hawks were included in the T1A modification. Here one of the team's aircraft carries the centreline gun pod and AIM-9L Sidewinders.* BAe Inset right: *Specially painted Hawk T1A – St Athan Station Flight.* PRM Above: *Hawk T1A firing SNEB rockets.* BAe

the flight test programme had been completed. It acquitted itself well and attracted considerable interest from the world's media and foreign buyers alike. By the time that the Show was over, and the initial flight trials had been completed on 11 September, XX154 had flown 26 times and amassed 17.5 flying hours. Throughout this time, the aircraft and its Adour engine had been totally reliable, much to the delight of all concerned.

This first Hawk remained on lay-up until 19 December 1974 when it re-emerged from the flight sheds at Dunsfold, complete with a full Flight Test Instrumentation fit. Flight testing could now resume in earnest and, in 1975, XX154 was joined on the flight test programme, by the first five production aircraft, XX156-XX160. There were few problems during the flight test programme and none could be regarded as a serious threat to safe operation of the aircraft.

Early Hawk development flying concentrated on fine-tuning the primary flight controls – particularly the ailerons and rudder – for more positive response and on improving wing stall characteristics and stall warning. An abrupt nose-down trim change at high speed, when the airbrake was selected, was also subject to investigation. These two problems resulted in minor cosmetic changes to the Hawk wing and rear fuselage, but as a result, handling characteristics were significantly improved.

As flight testing had progressed, so too had the weapon clearance programme, and by late-1976, the 30mm Aden gun pod, Matra 155 rocket pod and Carrier Bomb Light Store (CBLS) unit had all been successfully tested on the aircraft. Hawk XX156, the first camouflaged aircraft, had also successfully completed hot weather trials in Malta and Egypt. With initial Controller of Aircraft (CA) release granted in October 1976, the scene was now set for the Hawk to begin its long and distinguished career with the RAF. CA release for the weapons training configuration followed in July 1977.

Into service

With the arrival of two Hawk T1s (XX162 and XX163) at RAF Valley on 4 November 1976, a whole new era of flying training began. The first aircraft were initially used by a detachment of the Central Flying School to train the instructors for No 4 Flying Training School (FTS) at Valley. It was not until the early summer of 1977 that the first student pilots began training on the Hawk. Their Advanced Flying Training (AFT) course then covered 22 weeks and involved 75 hours of dual and solo flying, supplemented by 21 hours of tuition on the Hawk flight simulator. The first Hawk-trained student pilots graduated from No 4 FTS on 11 November 1977, just days before the station took delivery of its final aircraft from the initial batch of 25.

From January 1978, Hawk deliveries switched to RAF Brawdy and by June of that year 26 Hawk T1s were operational with No 1 Tactical Weapons Unit (TWU). The first graduates from Valley moved to Brawdy in the

Above: *Recent formation of three 4FTS Hawks – No 208(R) Sqn (top); CFS/No 19(R) Sqn (middle) and No 74(R) Sqn (bottom).* BAe

Left: *The* Red Arrows *gave their first Hawk display in November 1979.*

spring of 1978 and ultimately became the first Hawk-trained TWU graduates. Their course lasted 16 weeks, during which time they flew 64 sorties, comprising 18 hours dual instruction and 36 hours solo. As new Hawk aircraft arrived at Brawdy, so the resident single and two-seat Hunters were phased out, with the final aircraft departing in September 1979.

Nine modified Hawk T1s were delivered to RAF Kemble in 1979 for use by the RAF aerobatic team – *The Red Arrows*, that was still flying the Gnat through the 1979 display season. These Hawks, painted in the team's distinctive red paint scheme, incorporated a modified Adour turbofan engine offering a shorter throttle response time and, on the fuselage centreline, they carried a 70 Imp gallon smoke pod containing separate tank units for diesel oil and red and blue dye. When bled into the hot jet eflux, the diesel on its own creates white smoke, whilst injecting red or blue dye creates red or blue smoke. The *Arrows* gave their first Hawk display at Kemble in November 1979 before invited members of the world's press, but it was not until April 1980 that the team gave its first public displays. Since then, the team has displayed all over the world and has been a potent force in the promotion and marketing of the Hawk.

The RAF took delivery of its 176th, and final new-build Hawk, on 9 February 1982, but the honour of being the final Hawk delivered must go to XX158. It was one of the early flight development airframes which, having been totally refurbished by British Aerospace, was delivered to RAF Chivenor on 17 March 1982.

Expectations fulfilled

In its 21-year career, the Hawk has fulfilled – and in many cases exceeded – the objectives of its designers. The aircraft has proved to be safe, rugged, reliable and highly adaptable and to date has logged almost 600,000 flying hours. Of the 176 Hawk T1/1As delivered to the RAF, just 29 have been lost in accidents – a figure well below the originally projected attrition rate of 0.6 aircraft per 10,000 flying hours. No serious technical problems have been experienced with the Hawk – until fairly recently, when certain aircraft began to experience fatigue cracking in the wings and tailplane. Even then, the problems were confined to older aircraft operating in the punishing, high-speed, low-level, tactical weapons training environment. In 1989 the RAF, in conjunction with British Aerospace, began a rewinging programme and, by 1993, 83 aircraft had been suitably modified. Work on a second batch of 59 aircraft began in November 1993, and by June 1995 this programme will have been completed.

As for adaptability and mission flexibility, the Hawk's service record speaks for itself. Having begun life as an advanced flying and weapons training aircraft, it was soon modified for display flying with the *Red Arrows*. In addition to its tactical weapons training role, the TWU Hawks were given a front-line role and allocated to 'shadow squadrons' that would, in times of crisis, be capable of carrying out limited combat missions. Originally, the aircraft were only capable of performing restricted ground attack missions but the decision was taken in 1980 to extend this role to include a limited air defence capability. Between 1983 and 1986 88 Hawk T1s, including the aircraft flown by the *Red Arrows*, were modified by British Aerospace to carry AIM-9 Sidewinder air-to-air missiles, for close-in air defence of vital assets such as airfields and radar installations. These modified aircraft were subsequently redesignated as Hawk T1As.

Over the last five years, cuts in defence spending have progressively brought about a reduction in the RAF's requirement for pilot training. Since 1 October 1994 there has been just one fixed wing Advanced Flying Training School, No 4 FTS at Valley, which takes the student from BFT into AFT and on through the tactical weapons training ready to join an Operational Conversion Unit (OCU). The FTS is equipped with 72 Hawk T1/1As that are operated by Nos 74(R) and 208(R) Squadrons. The CFS (No 19(R) Squadron) continues its instructor training at Valley, with six Hawks. They will be joined later this year by a further nine Hawks when the fast jet navigator training element of No 6 FTS moves in from RAF Finningley. No 100 Squadron is equipped with 16 Hawk TI/1As for its target towing and radar target tasks. Although currently based at RAF Finningley, this squadron is relocating to RAF Leeming in the latter part of 1995. Other Hawk T1/1A operators include the Institute of Aviation Medicine (IAM), the Empire Test Pilots School (ETPS) at Boscombe Down, RAF St Athan Station Flight, the Defence Research Agency (DRA) and, from early-1994, even the Royal Navy. Redundant RAF Hawks have replaced Hunters with the Fleet Requirements and Direction Unit (FRADU) at RNAS Yeovilton.

Keeping them flying

From an engineering standpoint the Hawk T1 is a robust and uncomplicated design. The aircraft structure is manufactured almost entirely from aluminium alloy sheets, extrusions and machined components, with a small amount of steel being utilised for highly-loaded components. A small number of magnesium alloy castings are also incorporated in the structure.

The following account by Chief Technician Terry Riley, a highly experienced crew chief, now on his second tour of duty on the Hawk with No 208(R) Squadron, provides an engineering perspective:

Operational servicing of the Hawk T1 involves an on-going programme of inspections and routine maintenance, carried out at intervals of 125 flying hours. As flying hours accumulate, so the inspections become more rigorous until, after 2,000 hours the aircraft is flown to RAF St Athan for a complete inspection and comprehensive maintenance programme. Every 125 hours the Hawk undergoes a 'Primary' inspection at squadron level, during which the more accessible areas of the structure are examined for fatigue and other problems. The engine and primary systems are also checked and routinely maintained. The 'Primary' inspection is then followed by a 'Primary Star' inspection every 250 hours, a 'Minor' inspection every 500 hours and a 'Minor Star' inspection every 1,000 hours, leading to the 'Major' inspection at 2,000 hours.

Throughout the Hawk's service career, rigid adherence to this programme has provided

The Hawk has a major inspection at St Athan after 2,000 hours flying. PRM

timely identification and rectification of potential problems. This enables No 208(R) Squadron to maintain aircraft in a very high standard of flight readiness, normally aiming to have a minimum of ten aircraft on the flight line at any one time, so that an average of between 25 and 30 sorties can be generated each day, in three waves – with the option of a fourth wave during the summer months. No 208's Hawks will each normally fly between seven and ten hours per week, which equates to an average utilisation of 350 hours per aircraft per year. At present the Hawk T1/1A fleet leader has accumulated over 3,600 flying hours, but has a long way to go before reaching its originally specified design life of 6,000 hours. This is based on an average utilisation of 300 hours per year, over 20 years.

The future

In view of recent structural modifications to the Hawk fleet, the type seems set to remain in operational service for many years to come, providing valuable advanced flying and tactical weapons training for potential front-line RAF aircrew. However, while the Hawk T1/1A will continue to have considerable relevance to the training of Jaguar, Tornado and even Harrier aircrew, already doubts are beginning to surface about the aircraft's relevance to the training of aircrew destined for future Eurofighter 2000 squadrons. The Hawk T1's analogue instrumentation is a far cry from the sophisticated, digital avionic systems of the new fighter and clearly action will have to be taken to bridge this big technology gap.

On the one hand, the RAF could elect to retain the Hawk T1/1A as an element of EF2000 lead-in training, using the aircraft in its current operational roles, but then employing a mixture of ground-based teaching aids – such as Cockpit Procedures Trainers (CPT), Avionics Part Task Trainers (APTT) and flight simulators – to bridge the analogue/digital gap. This solution would however, place an additional training burden on the EF2000 Operational Conversion Unit, resulting in a longer and more costly training programme.

Alternatively, the RAF could opt for a 'Hawk' solution, using one of the latest Hawk variants – the Hawk 100 – to offset the shortcomings of the older T1/1A. Such a solution could offer considerable cost savings, as the Hawk 100 airframe, engine and primary control systems retain extensive commonality with those of the Hawk T1/1A. The Hawk 100 is a two-seat, lightweight fighter and advanced weapons systems training aircraft. It provides a cost-effective solution to fighter lead-in training, navigator and weapons systems operator training and can also undertake other operational missions, such as close air support, interdiction and reconnaissance. Principal features of the Hawk 100 include an uprated Adour Mk 871 turbofan of 5,845lb thrust, a seven station combat wing with combat flap setting, an advanced digital avionic system, including Forward Looking Infra-Red (FLIR) and a laser rangefinder. The Hawk 100's avionics system includes a high-performance Laser Inertial Navigation System (LINS), new generation Head-Up Display and Weapon Aiming computer (HUD/WAC) and a new, highly-accurate air data sensor. Operational data is presented to the crew on full-colour, head-down, multi-purpose displays and all avionic system components are linked by a MIL-STD-1553B databus. Also, in an effort to reduce cockpit workload, all time-critical weapon systems controls are grouped on the throttles and control sticks, using the HOTAS (Hands-On-Throttle-And-Stick) principle. The Hawk 100 is cleared to carry an extensive range of NATO and US weaponry on four underwing pylons and the fuselage centreline pylon, and can also carry wing-tip mounted air-to-air missiles for offensive or defensive purposes. The Hawk 100 would appear to be a good solution to the RAF's Eurofighter 2000 training requirements. British Aerospace is working closely with the RAF, in an effort to win Ministry of Defence support for a limited acquisition of the type.

Ultimately, however, in the early part of the next century, the older variants of Hawk, such as the T1/1A, will have to be replaced by a new trainer. In order to reduce development costs, the aircraft will almost certainly be a collaborative venture involving two or more partners. Whatever aircraft finally emerges, it will have its work cut out to surpass the excellence of the 'Hawk' – a real thoroughbred among trainers.

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BY ROYAL APPOINTMENT

Bob Archer & Flt Lt Rob Goodman

On 1 April 1995 No 32 Squadron at RAF Northolt amalgamated with The Queen's Flight to form No 32 (The Royal) Squadron. On that date the existing VIP and communications role of the Squadron was combined with the requirement to provide aviation support for the Royal Family, and it assumed responsibility for the three BAe 146 aircraft and the two Wessex HCC 4 helicopters, formerly operated by The Queen's Flight. This was the latest of many changes the Squadron has undergone in its 79 year history, since its formation as a Royal Flying Corps Army support squadron at Netheravon on 12 January 1916.

No 32 (The Royal) Squadron is established to provide air transport for Her Majesty The Queen, Members of the Royal Family, the Prime Minister, Government Ministers, the Chiefs of Staff, visiting dignitaries and other important persons in the course of their duties. In addition, the Royal Squadron also provides VIP communications flights for senior officers of all three services and senior civil servants. The three BAe 146s (operated by 'A' Flight) are capable of carrying a large number of people from relatively short airfields. Although it has a limited range, long distance flights can be undertaken by positioning the aircraft overseas to await the arrival of the Royal Party onboard a long range RAF or civil transport aircraft, chartered for the purpose. The crew complement on aircraft of The Royal Squadron is, by virtue of the task, somewhat different from that of other military squadrons. The 146 is crewed by two pilots, a navigator, a crew chief and an air loadmaster, supplemented by stewards as required by the size of the travelling party. The aircraft is comprehensively equipped to provide an exceptionally high standard, in all respects, for the passengers.

For short range work, the Squadron's helicopters (flown by 'B' Flight) give a fast, flexible service that is not confined to operation from established airfields. The two former Queen's Flight Wessex HCC4s are crewed by a pilot, a navigator and a crew chief, who also acts as a steward. One of the pilots is a Royal Navy officer. Fully equipped for operation in most weathers, the Wessex can provide a 'door to door' service. The Gazelles are similar to those operated by the Army, Royal Navy and RAF, but have been modified to HCC4 standard, including the fitting of an extra radio and a light-weight Doppler based navigation aid, for their VIP role. Crewed by a single pilot and with space for three (exceptionally four) passengers in the fairly small cabin, they are equipped with emergency floatation gear, as a fair proportion of their work involves flying in and out of London, following the River Thames. Passengers can be flown from small landing sites, close to their places of work, including the Westland Heliport at Battersea in Central London, to meet a fixed wing flight, or direct to their destination, with the great advantage of avoiding the traffic jams.

The BAe/HS125s of 'C' Flight are crewed by two pilots and a steward, two of the pilots on

Left: *Gazelle HCC4s entered service with No 32 Sqn as replacements for its Westland Whirlwinds, the last of which was retired in 1981.* PRM

Below: *BAe 125 CC3s ZD704 & ZE395 at Northolt. All the 125s have the Northrop MIRTS infra-red countermeasures suite in an extended tail fairing.* Bob Archer

Left: *No 32 (The Royal) Squadron is responsible for the three BAe 146s previously operated by The Queen's Flight.*

the Flight being RN Officers. The passenger compartment is fitted with three arm chairs, a single chair and a three-seat settee. The eighth seat is normally removed and replaced with a luggage rack. The small galley can accommodate quite extensive catering requirements and all meals are served on china and glass, rather than the disposable items usually associated with air travel. The aircraft can fly for as long as five hours, bringing such destinations as Cyprus within range, but most of the flights are within Europe and the UK. Although, without refuelling stops, it does not have transatlantic range, the 125 can position to points in the Middle and Far East and the Americas in the same way as the BAe 146s. All three elements of The Royal Squadron's equipment combine to provide an effective and efficient form of Royal and VIP transport, that saves many hours of frustrating and tiring travelling by other means.

While the Royal and VIP roles are the high profile side of the Squadron's operations, it also performs a host of other tasks which come under the umbrella of communications flying. Aircrew are collected and positioned for ferry flights, ground technicians are transported to repair unserviceable aircraft and personnel are positioned to support detachments and relocated in an emergency. The 125s also have the ability to act as an air ambulance and the facility to carry a small portable incubator.

Royal and VIP operations conform to three basic priorities. First and foremost is safety, secondly comfort and finally timing. Whereas safety is of paramount importance to all aviation activities, it has an additional vitality for No 32 (The Royal) Squadron by virtue of the rank and status of most of its passengers. The unit maintains the highest standards throughout its operations, including planning and engineering, to ensure that safety is never compromised. Passenger comfort is achieved by the careful design of the aircraft interiors, layout and facilities. Flights are conducted as smoothly as possible using small, gentle attitude and power changes to reduce cabin disturbance to the practical minimum. The engineering standards applied to the aircraft are second to none and the aircrew are selected from the best available in the RAF and RN, all of whom are assessed as being of 'above the average' or of 'exceptional' ability.

Royal flights are flown in Purple Airspace, reserved for the Royal aircraft, to eliminate even the slightest risk of collision.

Royal flights are flown in Purple Airspace, reserved for the Royal aircraft to eliminate even the slightest risk of collision. A NOTAM (Notice to Airmen) is published to inform other airspace users, giving details of the departure point, routing, planned height and destination of the Royal aircraft. The routing is carefully chosen and the flight plan is compiled. Diplomatic clearance is obtained where necessary and en-route refuelling and overnight stops are booked. The catering requirements of the party are ascertained, the food being prepared to the highest standards. Engineering support for the task is arranged by FR/Serco personnel, who maintain the aircraft under a Ministry of Defence contract. The flight's details are carefully checked before departure and, by the time that the aircraft positions to the departure point, nothing has been left to chance. Although most Royal Flights are planned well in advance, short notice tasks are not unusual. By their very nature these trips do not allow leisurely planning. However the vast experience gained over the years on the Squadron is such that they are accommodated with the minimum of disruption.

Whereas most civilian and RAF transport flights are operated as closely as possible to schedule, No 32 (The Royal) Squadron has to be flexible to the needs of its customers. Even Royal and VIP passengers can be delayed, or need to depart early to meet an unforeseen commitment. To cater for this eventuality, the Squadron positions its aircraft and crews early to ensure their availability. Once airborne the aircraft captain adjusts his speed and routing to achieve the required arrival time. Not early, thereby embarrassing the reception committee, and not late. As the crucial timing for a Royal or VIP flight is the 'doors open' time, which may follow a lengthy taxi pattern from the end of the runway, the Royal Squadron aircrew need to be familiar with the destination airfield or landing site. A 'dry run' or route proving flight is often flown during the planning phase of the sortie to eliminate any possible errors.

The BAe 146s fly worldwide, whilst the BAe/HS125s visit a wide variety of destinations within Europe, with regular flights to Brussels, Strasbourg and Luxembourg. An increasingly frequent destination has been the former Republic of Yugoslavia in support of the UK forces and the EU/UN peace initiatives in that area. The helicopters rarely leave the UK, using their ability to land in more inaccessible locations and often operate into city centres and palace grounds.

The background to No 32 Squadron's role in providing Royal and VIP transport can be traced back to the Metropolitan Communications Squadron (MCS), that was formed at RAF Hendon to provide aircraft for liaison and staff visits within the UK and Europe. On 3 February 1969 the MCS became No 32 Squadron and took over a variety of fixed wing aircraft and helicopters, including the Andover CC2, Basset CC1, Pembroke C1 and Sycamore HC14.

The Pembrokes were withdrawn from use in August 1969 and replaced initially by Westland Whirlwind helicopters. The

Former Queen's Flight Andover CC2, in recent grey paint scheme, on the apron at Northolt in February 1995, shortly before being withdrawn from service. PRM

Top: *VIP Andover CC2 whilst in service with The Queen's Flight.* PRM Above: *Sycamore HR14s served with No 32 Squadron until 1972.* PRM

Whirlwinds also replaced the Sycamores, the last of which was retired to the Cosford Aerospace Museum in August 1972, where it still remains on display. Additional Andovers were acquired during the 1970s as they became available from overseas Commands and in March 1971 the Squadron received the first of four Hawker Siddeley 125 CC1s. A military version of the HS125 Series 400 civilian executive jet transport, it was fully equipped for airways flying and could take up to six passengers to their destinations more quickly than had hitherto been possible with the other Squadron aircraft. They were supplemented by a pair of 600 Series HS125 CC2s in April 1973. These new aircraft were slightly longer than the 400s and could carry up to eight passengers.

The Bassets were withdrawn from use in 1974 as their role had been largely taken over by the more flexible helicopters. In May 1976 the Squadron received the first of four Westland Gazelle helicopters. These specially up-graded HCC4s eventually replaced the Whirlwinds, the last of which was retired in November 1981. Once the Squadron had stabilised with its new equipment, three flights were created, operating the Andover, Gazelle and HS125 respectively.

In February 1983 the first of six British Aerospace 125 CC3s was delivered. Equivalent to the 700B series civilian model, the aircraft had many improvements over the older variants. The most noticeable, certainly to an outside observer, was its quieter, more powerful Garrett TFE731 turbofan engines. These were retrofitted to the CC1/2s of the existing fleet during the 1980s. In 1991 the aircraft changed their appearance markedly when they were repainted from the standard transport aircraft scheme of white and grey to a low visibility overall grey scheme, with pale blue and pink markings. The 125s were also fitted with a Northrop MIRTS infra-red countermeasures suite mounted in an extended tail fairing. During the same period the number of Andovers was increased with the acquisition of a CC2A from The Queens Flight, and a C1 and an E3A from No 115 Squadron.

By 1991 No 32 had become the largest squadron in the RAF, with 24 aircraft on strength – eight Andovers, four Gazelles and 12 BAe/HS125s. On 31 March 1994, the 125 fleet was reduced by a third, when the four CC1s were withdrawn from service, and sold to new owners in the USA. On the same day the Andover fleet was reduced to two, with the E3s being sold for civilian use. This left CC2 XS794 and CC2A XS789 to soldier on until 31 March 1995, when they were retired. These were the last two Andovers in RAF squadron service.

The King's Flight was officially formed at RAF Hendon by King Edward VIII on 21 July 1936. The Flight's first Captain was Wing Commander E H 'Mouse' Fielden (later Air Vice-Marshal Sir Edward Fielden GCVO CB DFC AFC) who remained in charge for more than a quarter of a century. It moved to RAF Benson, some 40 miles west of London, in September 1939. A new role was given to the Flight in 1942 and it disbanded to form the nucleus of No 161 Squadron that was engaged on special operations, often involving the landing of agents and equipment behind enemy lines.

The King's Flight re-formed on 1 May 1946 with four Vickers Vikings, one for the King's use, another for the Queen, the third for crew support and the fourth fitted out as a flying workshop. On 1 August 1952, following the Accession of The Queen, the Flight was renamed The Queen's Flight and between 1955 and 1961 the Vikings were replaced by de Havilland Herons. In 1959 two Westland Whirlwind helicopters were added, although other helicopters had previously been used on loan. In 1964 the first twin-turboprop Andover CC2 joined the Flight and in 1969 two Wessex helicopters replaced the Whirlwinds. The first of three BAe 146s was handed over in April 1986, with the second aircraft arriving two months later. In January 1991 the final 146 was delivered, replacing the last of the Andovers which, after 27 years service, joined A Flight of No 32 Squadron.

The Queen's Flight fixed-wing aircraft are all painted in a distinctive red, white and blue livery and when on the ground they fly the Personal Standard of the Member of the Royal Family on board. For many years the Captain of The Queen's Flight acted as adviser to The Queen on all aspects of Royal Flying and was assisted by two Deputy Captains. The post of Captain of The Queen's Flight has now lapsed, having been replaced by the Senior Air Equerry to The Royal Household who is based at RAF Northolt.

The tasks allocated to No 32 Squadron have changed over the years but it has not been found wanting. Now, as the Royal Squadron moves on with a new, wider role, its personnel can be relied upon – as have their predecessors – to respond to the Squadron motto '*Adeste Comites*' ... Rally round Comrades!

Right top: *A distinctive bright red colour scheme is carried by the two Wessex helicopters operated by No 32 Sqn.* PRM

Right: *The last Queen's Flight Andover was replaced in January 1991, on delivery of the third BAe 146.* PRM

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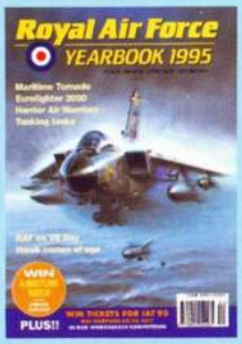

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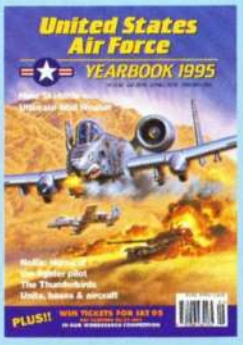

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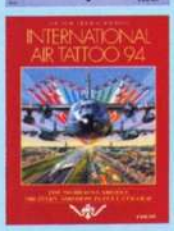

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The Flying Can Openers

Lindsay Peacock

Claiming the distinction of having been on unbroken operational service since it formed at South Farnborough in 1914 as part of the Royal Flying Corps, No 6 Squadron is one of three units that constitute the RAF Coltishall-based 'Jaguar Wing' – and has been so for more than 20 years. It has not always been this way, since No 6 Squadron has spent over half of its existence, from 1914 to 1969, serving overseas.

Throughout much of that long period, the squadron resided in the Middle East, winning an enviable reputation in recognition of its prowess in supporting Army ground forces. Those exploits undoubtedly reached a peak during the campaigns that raged across North Africa in World War 2, when cannon-armed Hurricane IIDs devastated Rommel's Afrika Korps. Indeed, the successes at that time resulted in No 6 being nicknamed *The Tank Busters* or the *Flying Can Openers* and a winged can opener motif still appears on the Jaguar today, over 50 years on from those events.

The end of hostilities in 1945 did not lead to an immediate return home, as No 6 Squadron stayed in the Middle East, flying types like the Spitfire, Vampire, Venom and Canberra from bases in Egypt, Iraq, Israel, Jordan and Cyprus. Eventually, cuts in overseas commitments cleared the way for a return in January 1969 when No 6 said goodbye to the Canberra B16 at Akrotiri, Cyprus and moved to Coningsby. Four months later, it became the first fully operational RAF unit to equip with the Phantom FGR2.

As it transpired, the Phantom era spanned barely five years, with conversion to the Anglo-French Jaguar coming at Lossiemouth in the latter half of 1974. Ultimately, re-equipment was accompanied by a change of station and No 6 moved to Coltishall on 6 November that same year. This Norfolk base is still home at the present time, although the unit has spent much of the 1990s on overseas duty.

In the main this stems from routine operational needs, with such activities as missile firing practice, exchange visits, NATO exercises and realistic 'war games' like *Maple Flag* and *Red Flag* exercises necessitating frequent detachments away from base, either in part or as a complete entity. However, by no means all of the periods away from home are driven by the need to maintain combat proficiency, for the past few years have involved units of the 'Jaguar Wing' in operations that presented much greater hazards.

The most widely publicised instance came in 1990-91, when a dozen Jaguar GR1As were despatched to the Gulf region. It was, in fact, No 6 Squadron that led the way by providing almost all of the resources that were so hastily deployed. At the outset, they were primarily concerned with helping to forestall further military adventures by Iraqi forces, but they were still present when the time came to go on the offensive in order to liberate Kuwait. Operating initially from Thumrait in Oman and latterly from Muharraq in Bahrain, the *Desert Cats* roster included several pilots from No 6 Squadron and some were still there when fighting began in January 1991. The end of that brief but violent conflict six weeks later did not bring a halt to missions over Iraq, for aircraft and pilots from Coltishall next took part in Operation *Warden*. Flying from Incirlik in Turkey, they played a key role in enforcing the northern 'no-fly zone' between 1991 and April 1993 when the Harrier took over.

The subsequent lull in activity was brief, with just three months elapsing between returning

After its return to the UK, Phantom FGR2s equipped No 6 Squadron from 1970 to 1974, prior to the introduction of Jaguar GR1s. Ian MacFarlane

Above: *The* Flying Can Openers *provided much of the initial assets despatched to the Gulf in 1990 and played a major part in the* Desert Cats *operations from Muharraq.*

to the UK and setting off again. This time, it was to Gioia del Colle in Italy – and No 6 Squadron was chosen to get the ball rolling as part of the multi-national effort to enforce another 'no-fly zone'. This one was located over war-torn Bosnia and Operation *Deny Flight* began for No 6 on 16 July 1993, when the squadron ferried 12 Jaguars to Italy. From that day it has shared responsibility for manning the Gioia detachment with its sister units, Nos 41 and 54 Squadrons, from Coltishall.

Since being established, the size of the detachment has been slightly reduced but it should be noted that all three squadrons actually take turn-and-turn about in providing resources to the Gioia-based operation, with each tour of duty spanning about two months. Today, the number of aircraft usually present in Italy is nine, although three more of the anonymous-looking, grey-painted jets are kept on alert at Coltishall, ready to head south in the event of reinforcements being required.

Harking back to the human resources, it is also usual for each squadron to assign nine pilots to *Deny Flight* – and since all of the Jaguar outfits actually possess about 16 pilots, it is necessary to rotate them so as to ensure the load is equitably spread. In general, then, every combat-ready pilot on a particular squadron will spend four to five weeks in Italy.

Moreover, since the work pattern uses a 'six-days on/two-days off' roster and as the Jaguars fly almost every day, the pilots are kept busy while at Gioia. In fact, each will typically log about 20 sorties during a tour. On an upbeat note, that is perhaps slightly more flying than at home, but there is a penalty in as much as the working day is almost always considerably longer and nobody really relishes the time spent away from home. Despite that, personnel take a positive view of the nature of the task and morale remains excellent across the force. Of course, once the cycle of planning, briefing, flying and debriefing a mission has been completed, the pilots are effectively off duty and free to relax.

Returning to No 6 Squadron in particular, mention has been made of the fact that it was responsible for getting the Gioia detachment off to a good start. Since the opening tour, it had been back several times and was clearly well-versed in the procedures applicable to operations over Bosnia. So, while the methodology utilised on Operation *Deny Flight* is relevant to the other Jaguar units, it is worth emphasising that what follows stems from conversation with the *Flying Can Openers*.

Considering the Jaguar first, the basic configuration of the aircraft assigned appears identical to the *Desert Cats'* aircraft, with the only specific modification concerning provision of a second radio to facilitate communication with the various command and control agencies in the theatre. The normal 'rig' does, however, differ to some extent from that utilised in the Gulf War, in that the Jaguars invariably carry auxiliary fuel tanks on the inner wing stations, rather than the centreline.

Otherwise, there are few changes. Overwing missile rails are standard, with two AIM-9 Sidewinders always present to provide a measure of self-defence in the unlikely event of being challenged by hostile fighters, while a jamming pod, flare and chaff dispensers furnish additional protection. Moving on to offensive weaponry, the Jaguar can carry a range of weapons but invariably carries 1,000lb bombs. These were used extensively in the Gulf War to good effect and are the mainstay of the Jaguar's weapon inventory. In more than a year of *Deny Flight* operations, the Jaguar has been called upon to strike an objective on only two occasions. The first event occurred in late September 1994, when French personnel called for air support after a Bosnian Serb Army (BSA) rocket attack – and it was more by way of a retaliatory gesture, with a static T55 tank in the Sarajevo exclusion zone providing the target. This was duly destroyed after the BSA had been informed of the impending action and given time to evacuate. Jaguars also took part in the attack on Udbina on 21 November as part of the largest raid in NATO's history. On both occasions another unit was on duty and No 6 Squadron has not yet been called upon to demonstrate its skills. It has come close on several occasions, including one when it was alerted to bomb a target but as it turned out, a combination of factors, including bad weather, prevented the attack from being carried through.

The Jaguar's self-defence armament has been provided by AIM-9L Sidewinders mounted on overwing rails since 1990.

Even though the requirement to utilise weapons may be scarce, the Jaguars are certainly no strangers to Bosnian airspace, for they are tasked to fly operational training sorties to the region almost every day and with in-flight refuelling it is possible to cover the whole of the country.

While the Jaguar has been around for a long time, it continues to demonstrate excellent reliability, which is best exemplified by the fact that the Gioia detachment generally looks to accomplish eight sorties a day – and could raise that rate if tasked to do so by NATO.

Missions are invariably flown as pairs since there is a need for mutual support and a two-ship is the minimum number that meets this

Left: *Two of the invaluable Tracor AN/ALE-40 flare packages can be seen under the Jaguar's rear fuselage.*

ROYAL AIR FORCE

requirement. In general, three of the daily pairs will be configured for close air support, while one will be tasked with reconnaissance. After transiting the Adriatic and entering Bosnian airspace at medium altitude, the leader of the pair of close air support Jaguars makes contact with the Forward Controlling Agency (FCA), which may be on the ground or in another aircraft like an A-10. It is the FCA's responsibility to allocate the Jaguars' target – and since some targets may consist of just a single tank or artillery piece in good cover, this can take time and requires careful consultation to satisfy the formation leader that the required target has been identified.

In the meantime, the wingman is not left to fly around aimlessly, having responsibilities of his own to fulfil. As ever, the primary concern is that of 'minding' his leader, whose attention will be occupied by the business of finding the objective. Thus, the wingman is expected to be alert to threats. These may be minimised by flying at medium altitude, but they cannot be ignored, for a lapse in concentration could well have dire consequences. In addition, the wingman also deals with other communications, such as with the Boeing E-3 airborne early warning aircraft that will be monitoring air traffic in the area from a safe orbit some distance away.

Once he is happy that the target has been correctly identified, the formation leader next briefs his wingman on its precise location – and the pair will then prepare to carry out an attack. This may actually entail climbing to even higher altitude, before rolling in for a dive-bombing pass, in order to avoid radar-directed anti-aircraft artillery, missiles or small arms fire. It is an old adage, but a true one, that extra height means extra safety when facing ground-based threats – and anything that increases safety has to be good.

For the reconnaissance aircraft, though, life is more in earnest, since they are used to gather information on what is happening in the theatre and to monitor the UN safe areas. As already noted, one recce pair is usually in action on a daily basis. The Jaguar can carry the Long-Range Oblique Photography (LOROP) pod or the BAe pod with an F126 survey camera, that are designed to provide detailed imagery of the area of interest.

While *Deny Flight* is arguably the most interesting and potentially the most exciting aspect of No 6's current duties, it is far from the only one, for detachments to Italy only account for about four months out of every 12. The rest of the year is spent in training activities that might best be called 'peacetime normal', even though Bosnia itself has a considerable impact on other more routine facets of squadron life.

Since the Gulf War, reconnaissance Jaguars have carried the LOROP (Long-Range Oblique Photography) pod or the BAe pod with an F126 survey camera. LOROP imagery possesses high resolution qualities but only covers a narrow swathe and lacks a data matrix, while the broader F126 imagery allows interpreters in the Reconnaissance Intelligence Centre to take a general look before they turn their attention to the 'take' from the LOROP system.

This is perhaps most evident when considering the process of maintaining combat-ready status, for this is something that is generally achieved by all pilots at a fairly measured pace over a 12-month period. Now, with four months of the year taken up on detachment to Gioia, the rest of those objectives have to be compressed into just two-thirds the amount of time usually available – and with less time to demonstrate proficiency and earn the necessary 'ticks', this inevitably creates extra pressure.

For a start, the training burden is slightly increased. The time reduction makes sure of that, but there is also a need to practice and perfect theatre-specific tactics relating to Bosnia, as well as ensuring that all pilots remain 'up to speed' in a host of other disciplines and skills. As far as flying proficiency is concerned, this includes such techniques as in-flight refuelling, various types of weapon delivery, low-flying and battle tactics. Those will clearly be tackled in an enthusiastic way, since No 6 is no different from any other unit in having pilots that like to fly whenever they can.

In addition, time must also be found in the planning process for other more mundane things that are also part-and-parcel of life for an RAF squadron, even though they are not as stimulating as flying. Leave is one that is perhaps not entirely unwelcome; medical examinations and dealing with the paperwork are others that will be greeted less eagerly. Regardless, it all has to be dealt with – and in less time than is normally available.

Generally speaking, No 6 continues to train and prepare for the worst case scenario. It is by no means unique in that, for it is only one of many units engaged in the type of training accomplished in the days when the Warsaw Pact was perceived to be 'the threat'. The old certainties may have gone, swept away with the end of the 'Cold War', but the need for proficiency in the kind of tactics that evolved then certainly has not diminished. So, heavy

Right: *Most photographs show the principal ordnance carried on Operation* Deny Flight *Jaguars as one or two examples of the 1,000lb bomb carried on the aircraft's centreline.*

Below: *Resting back at Coltishall, a* Deny Flight *Jaguar displays the range of weapons available for self-defence and attack.* Andrew March

emphasis is still placed on low-level work, since the process of adapting from low to medium or high level bombing is much less demanding – whereas it is infinitely harder to make that transition in the reverse direction. In view of that, developing expertise in this area remains vital and will do for the foreseeable future. It is not the only aspect of training, of course, with most sorties offering opportunities to enhance proficiency in multiple disciplines, for a pilot has many other talents to acquire before he can be classed as combat-ready.

Consequently, squadron members also devote a fair amount of time to honing weapons skills by frequently visiting range areas to perfect various delivery techniques at all altitudes, by day or night. Practice bombs that are able to replicate the ballistics characteristics of the real article are most commonly used, but full-size 1,000-lb bombs are also frequently carried so as to give experience in handling heavily-laden aircraft. However, there are fewer places where these may be deposited – and most of those that are dropped are actually inert, containing nothing more lethal than concrete.

Other weapons work entails the carriage of inert acquisition rounds of the heat-seeking AIM-9L Sidewinder – and live missiles are periodically fired during detachments to RAF Valley. Gunnery also appears on the agenda, mainly in an air-to-ground 'strafing' mode, for while the Jaguar can carry air-to-air missiles, it is not the most ideal machine in which to engage in air combat. As a result, if 'bounced' by fighters, the overriding philosophy is one of evasion as opposed to confrontation.

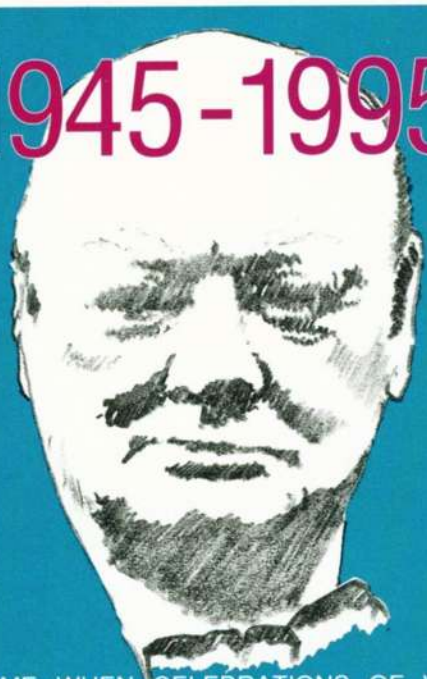
In simple terms, the Jaguar pilot will try to run away as quickly as possible (and as bravely as possible) so that he may fly and fight on another day. Fundamentally speaking, the pilots who fly it are trained to overcome the Jaguar's limitations and survive in a hostile environment, a process that also entails recognising the aircraft's more positive qualities. As far as the latter are concerned, it is a stable weapons platform; it is very much at home when flown at very low level; and it has good 'kit' for accurate weapons delivery.

A No 6 Squadron Jaguar GR1A firing one of its two AIM-9L Sidewinders. Geoff Lee

Furthermore, it is set to receive an important new addition to that equipment in the very near future. This is the GEC Avionics TIALD (Thermal Imaging And Laser Designation) pod, development examples of which received a thorough combat work-out in the Gulf War. After further trials, the system is now on the brink of service-entry, with the first of ten modified aircraft (designated Jaguar GR1B) due to enter service at Coltishall early in 1995. A pair of two-seat Jaguar T2Bs are also being converted.

At the moment, Jaguar pilots certainly are not unfamiliar with laser-assisted bombing, for the GR1A has a Ferranti LRMTS (Laser Ranger and Marked Target Seeker). However, they have thus far been dependent upon outside sources for laser marking and the forthcoming introduction of TIALD will eliminate that dependency by allowing them to 'self-designate' for the first time. Clearly, this new capability will offer benefits in the areas of combat potential and operational flexibility. In so doing, it will allow No 6 Squadron and its sister units of the Coltishall 'Wing' to continue to extract the very best from a warplane that has already proved its worth in the toughest arena – the field of battle.

1945 - 1995



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Left: *ETPS Lynx AH7 ZD560 undergoing a handling exercise. Note the extended pitot tube attached to the port side of the nose.* All photographs A&AEE Boscombe Down unless otherwise credited

TRAINING TO TEST

Peter J Cooper takes a look at the world's foremost pilot training establishment, producing qualified test pilots and flight test engineers – the **Empire Test Pilots' School**.

During the infancy of the Royal Flying Corps when, by today's standards, their somewhat flimsy machines were being stretched to new tasks, it did not take long before an Experimental Flight was formed on what is now known as Salisbury Plain, at Upavon Aerodrome, then the home of the Central Flying School (CFS). This Experimental Flight was indeed necessary as there were no other test facilities for aircraft in existence, many of the pilots learning about the suitability of the performance and handling qualities of their steeds by the 'seat of their pants'.

Renamed the Testing Squadron in 1915, the flight relocated two years later to the somewhat bleak aerodrome of RAF Martlesham Heath. Subsequently renamed the Aeroplane Experimental Station, and with the addition of armament testing to its role, the official title of 'Aeroplane and Armament Experimental Establishment' (A&AEE) was granted.

Having moved to Boscombe Down in 1939, the A&AEE found itself with a considerable number of aircraft to deal with during the wartime years. They ranged from new types entering service from within Britain and from manufacturers in the USA, as well as many one-off prototypes and captured enemy aircraft, all demanding assessment acceptance and clearance trials. This task was further complicated by the rapid technological advances being made and it highlighted the shortage of properly qualified test pilots who could put these aircraft through their paces to determine their operational flight envelope, their handling characteristics, and their potential.

Up to this time the A&AEE, Royal Aircraft Establishment (RAE), the three air arms and manufacturer's pilots had learned their assessment skills through practical experience. These pilots were perhaps in a class of their own, being the best available at the time, and their high levels of skill enabled them to cope with difficult and demanding situations that in the hands of an average, or operationally inexperienced pilot, could have been extremely difficult or even disastrous. By the end of 1942 it became abundantly clear that there was an urgent need for specialised test pilot training as the workload and shortage of suitable test pilots at Boscombe Down had become critical. Early in 1943 the A&AEE Commandant, Air Commodore D'Arcy Greig, was tasked by the Controller of Research and Development, Ministry of Aircraft Production, to establish the world's first test pilot school at Boscombe Down. Its terms of reference included the task 'to provide suitably trained pilots for test flying duties in aeronautical research and development establishments within the Services and aircraft industry.'

Two of Boscombe Down's key figures were chosen to start the School. Mr G MacLaren Humphreys, a civilian technical officer, was appointed Chief Ground Instructor while the Officer Commanding 'A' Flight, Squadron Leader Sammy Wroath, was promoted to Wing Commander and became the first Commandant of the new Test Pilots Training Flight.

A number of Nissen huts on the southern side of Boscombe Down airfield were taken over as classrooms, operations and administration buildings. The first course commenced on 10 June 1943 with 18 student candidates, selected from RAF and RN officers. The first aircraft on strength included a Halifax V, Master III, and a Hurricane I. Aircraft from the A&AEE, and various other loaned examples were used by the Flight as and when required, with others being gradually added to the fleet. The initial course ended in February 1944 without ceremony, injuries or crashes. The graduate test pilots were the first to have the honour of using the letters 'tp' after their names.

With the start of No 2 Course in 1944, further buildings were acquired and the course membership grew to 28 students. By now the Commandant was Group Captain 'Sam' McKenna and the Flight had been renamed the Empire Test Pilots' School (ETPS), as it still is today. The prefix 'Empire' was incorporated into the title in recognition of the many overseas and Commonwealth students that were being trained. While flying a Mustang on 19 January 1945, Group Captain McKenna was tragically killed when his aircraft dived straight into the ground having suffered a structural failure of the wing. To this day his memory is perpetuated by the McKenna Graduation Dinner and the cherished McKenna Trophy which is awarded annually to the best Fixed Wing student pilot on the course.

By October 1945 the A&AEE had expanded considerably and, despite the inevitable interruption to training schedules, it was decided that the ETPS would be relocated to the quieter airfield at RAF Cranfield, Bedfordshire. Here the next three courses, Nos 4, 5 and 6 were conducted, before another move was made in August 1947, this time to RAE Farnborough. Although located at first in the famous 'Black Sheds', the School was soon established on the southern side of the expanding airfield where two hangars, an operations building and dispersal area were set up adjacent to the Army's golf course. At the time of this relocation and with the commencement of No 7 Course, the ETPS had a fleet of 29 aircraft, including Lincolns, Mosquitos, Vampires, Meteors, Tempests, Harvards and even Olympia sailplanes.

It was during December 1949 that the official armorial bearings and crest were issued by the College of Heralds, and the motto '*Learn to Test – Test to Learn*', was

At Boscombe Down in the early ETPS days (circa 1944/1945), the School's fleet comprised various Spitfires, Tempests and Harvards. Note the Nissen hut-type accommodation and classrooms.

Left: *A typical Ground School classroom lecture being conducted for course students of several different nationalities.*

Inset left: *ETPS instructor and student about to board the Hawk T1 ASTRA for a routine handling sortie from Boscombe Down.*

Main picture: *ETPS Jaguar T2 XX830 flying with Hunter T7 XL612 during November 1990. The Jaguar is fully instrumented and fitted with the latest head-up displays and video recorders, whilst the Hunters are actively engaged giving the students experience in the erect and inverted spin characteristics of swept wing aircraft.*

Hunters and Hawks in the ETPS hangar during April 1989. These include A&AEE aircraft as well as some of the ETPS fleet.

Jaguar T2A XX145 undergoing an engine change, with its starboard Adour about to be removed.

granted. They were presented at a ceremony on Horse Guards Parade that was addressed by Marshal of the Royal Air Force Lord Tedder.

The development of helicopters was progressing very fast, with new rotary craft entering service with many of the world's major air arms. Rotary-wing test flying was done, at this time, by fixed-wing test pilots who were cross-trained on helicopters after completing their ETPS course. As the complexity of the machines grew and the task became more challenging, it was clear that there was a requirement for specially trained helicopter test pilots. During 1963 a dedicated rotary wing course was added to the School's programme, geared to produce qualified helicopter test pilots. Prior to the start of this specific course a Sycamore and several Dragonflies and Whirlwinds had already been operational with the School.

During the 1950s and 1960s ETPS expanded rapidly and it was during these years that the professionalism and high reputation of the School and all that it taught was heralded around the world. Other countries, envious of the ETPS' achievements, followed suit. Two graduates from the ETPS, one from the USAF and the other from the US Navy, returned home to establish test pilot training schools for their respective air arms modelled on the ETPS. The USAF Test Pilot School was formed at Muroc Air Force Base, California (now Edwards AFB) and the US Navy Test Pilot School at Patuxent River, Maryland.

Amidst much controversy the ETPS moved from Farnborough back to Boscombe Down

Above: *The ETPS fleet at RAE Farnborough during 1961. The photo shows a Vampire T11, Meteor NF14, Meteor T7, Hunter F4, Hunter T7, Devon C1, Dragonfly HR1, Shackleton MR2, Canberra B2, Swift F7 and Chipmunk T10, these all being representative of the aircraft flown in the 1960s.* DRA Farnborough

Seen during April 1977 on the ETPS ramp at Boscombe Down, the School's fleet of Hunter T7, Jet Provost T5, Canberra T4, Basset CC2, Wessex HAS3 and HU5, Jaguar T2, Lightning T5, Andover C1, and Argosy C1. The Andover and Hunter still remain with the School.

during January 1968, having transferred originally from the base some 23 years previously. Course No 27 commenced with few changes of aircraft from those operated at Farnborough, in somewhat more modern buildings. The modernisation has continued and today the ETPS remains at Boscombe Down with its mixed fleet of 17 fixed- and rotary-wing aircraft. Its well-equipped classrooms, operations centre, engineering and student facilities are only a short distance from where it all began 52 years ago.

The School's work has changed little during this time, although the titles of the various organisations that it serves have been transformed quite recently. The ETPS' tasks today are to train specially selected:

– pilots from the RAF, RN and Army Air Corps, as experimental test pilots, for duties in the Ministry of Defence (PE), in support of the Defence Research Agency (DRA) and the Directorate General Test & Evaluation (DGT&E).

– civilian pilots from the British aerospace industry and pilots of Commonwealth, Allied and friendly nations for test flying duties.

– personnel of the MoD(PE) and others for flight test engineer duties.

As an additional task, the School, on behalf of the MoD (PE), conducts instrument rating tests for military and civilian test pilots and carries out specific pilot conversion or refresher flying courses.

Applicants for the ETPS course are expected to be fascinated by aeroplanes and they should be well informed regarding aviation in general. A thorough, in-depth, and recent knowledge of their operational role and the aircraft types they have flown are a necessary requirement. They should also be competent in basic mathematics and aerodynamics. A candidate would normally be expected to possess the a wide range of appropriate qualifications. These will include an exceptional or above average flying assessment, a recent operational tour in any Service role, a minimum academic standard equivalent to GCSE level in mathematics, a degree or HNC in a science or engineering related subject (desirable), at least four years still to serve from the beginning of the course, in recent flying practice with at least 750 hours as pilot in command, be aged 35 or under and hold a full flying medical category.

All ETPS applications are processed by the Director of Flying MoD (PE); overseas candidates initially apply through their own Defence Ministries to the MoD(PE) via their respective High Commissions or Embassies in London.

Each course comprises around 20 to 25 students. Together with colleagues from their sister services, RAF pilots are joined by the cream of the aircrew from many parts of the world. This exciting mix of background and experience is a cocktail crucial to the broadening nature of the course. Upon arrival at ETPS at Boscombe in early January, the students start an intensive year of academic study, flying and report writing which, by their mid-December graduation, has taken them through every nuance of modern flight testing. The full range of performance, handling qualities and avionic systems assessment skills are taught.

The year at the School is split into three terms. The first term begins with a short period of foundation ground school attended by all of the students. This session brings them up to a common standard in aerodynamics, thermodynamics, mathematics and statistics. The fixed- and rotary-wing courses then go their own ways for the remainder of the year, although some joint lessons are held for subjects of common interest such as avionics systems, as well as for the large range of specialist subjects taught by visiting lecturers.

A short conversion onto the ETPS aircraft is the first flying undertaken, so that the students are ready for the first test flying exercises. Fixed-wing students are cleared to fly the Hawk, Jaguar and one of the two large aircraft (BAC 1-11 or Andover), while the rotary course pilots are checked-out on the Gazelle, Scout and Lynx. Later exercises call for conversion to Hunter or Sea King, when the special qualities of these aircraft are required for the syllabus exercise. By the end of the year the students will have flown all of their fleet aircraft plus further types they are offered on visits or are rented specially to enrich their flying experience. This broadening of flying skills is fundamental to the test pilot and flight test engineer training. It is only through the exposure to a variety of flying qualities can the lessons in the classroom be properly illustrated.

Working either individually, or in small syndicates of three or four, the students tackle the early exercises which are mainly performance test flying of a fairly straightforward nature. Early stability and control exercises are then introduced and these crucial handling quality exercises go on to form the key feature of the second term. After the essentially routine assessment of pressure error corrections, range and endurance, climb, hover and descent performance and early longitudinal stability, the second term introduces lateral and directional stability and control and manoeuvre boundaries, as well as the more specialist exercises peculiar to the fixed- or rotary-wing streams. Here the stalling and spinning, together with the low-level navigation and weapon systems exercises of the fixed-wing course, run alongside the helicopter engine-off testing, single-engine climb-away and navigation systems assessment of the rotary-wing course.

At the same time the flight test engineer students work closely with their pilot colleagues, leading syndicate exercises and flying with them to gather data. Specific exercises for the engineers introduce practical trials planning and monitoring on both fixed- and rotary-wing aircraft, including systems assessment in the BAC 1-11, where flight navigation computer system performance (determined from pure inertial as well as satellite navigation systems) are assessed for specific missions.

By the end of the frenetic summer term much of the core syllabus is done and the students move on to important advanced

topics, as well as reinforcement exercises, to compliment the subjects already taught. The fixed-wing students' advanced flight control systems exercises are matched by automatic flight control and stability augmentation systems testing by their rotary-wing colleagues. The School has an extensive fleet, fully instrumented for flight test and complemented by air-to-ground telemetry of flight data and, in the case of the Tornado F2, head-up-display video. Bespoke software packages, running on PC and the Establishment's mainframe computer, simplify data reduction so that time spent understanding the results is maximised.

Crucial to the business of modern flight test is the ability of the test crews to communicate their findings effectively. Through the medium of presentations, post-flight debriefs, committee meetings and extensive written reports the students learn this important art. Some say the ETPS students become equally at home on the word processor and graphical packages as they are on the School's aircraft. It is this reporting that causes the long hours for both staff and students – the day is for listening and flying and it is the evenings that take the strain of the writing.

Both streams benefit from the ETPS's Variable Stability System (VSS) assets, as well as from specialist machines hired by the School. The venerable but irreplaceable Basset CC2 VSS aircraft is complimented by the unique fly-by-wire variant of the Hawk, to give grounding and exposure to a wide range of handling qualities, as well as introducing some of the more esoteric flight control laws now commonplace in modern fly-by-wire designs. For the rotary students early lessons from the Basset are complicated by a variable stability helicopter which is brought to the School from Germany for a brief period. Future plans include a more comprehensive VSS fit for the ETPS Lynx. With these VSS aircraft the huge range of ground school control system theory, evolved by computer simulation can be introduced for real in the air in one aircraft.

The demanding year finishes with the 'Preview'. Working in small teams the students are given just ten hours to assess an aircraft they have never flown before. Here the generosity of the sister schools of ETPS in France and the US provides exciting front-line aircraft for assessment and a completely different venue in which to study both the Preview aircraft and the test methods and philosophies of the host nation. Typical types offered to teams include the F-series fighters (F-15, 16 and 18) as well as Mirage 2000, P-3 Orion, AH-64 Apache, UH-60 Black Hawk, AH-1W Cobra and Super Puma. The Preview aircraft is assessed for a particular role, mirroring the process the students will face in real life. This valuable flying experience compliments the extensive flying broadening given by the School fleet and adds to the wide range of other types flown through the year. A typical score for a graduating fixed-wing test pilot can top 30 types in the year. His rotary colleague will have a similar catch and both will have benefited from cross flying on the other's fleet.

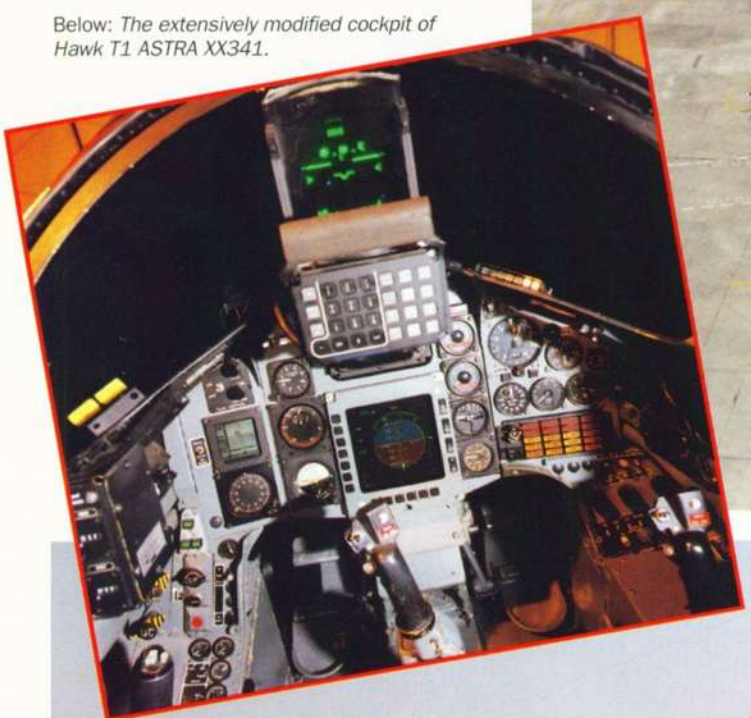
Once it is all over, what next? Graduates of the School return to official test centres all over the world to play crucial roles in the test teams clearing new aircraft, systems upgrades or accepting new variants. Increasingly important is the need for graduate test crews to fill the role of 'intelligent customer', to complete the professional interface between the customer (the operational crews) and the manufacturer. Nations may not need fully fledged flight test centres but they certainly need the experts to help select new equipment and to join in the approvals process at manufacturer's sites or host test centres. Like all highly specialist training, the test pilot and his engineer colleague does not come cheap but compared to the cost of the equipment he is asked to assess, where mistakes are expensive, he is irreplaceable.

Some exciting future aircraft selections lie ahead and each brings new challenges. In the UK, the Eurofighter programme and the new transports (C-130J and possibly FLA) and maritime aircraft (Nimrod up-grade or replacement) are fixed-wing needs that match the rotary-wing tasks presented by the coming RN Merlin, RAF helicopter transport (EH101) and British Army attack helicopter plans. Beyond practical flight testing or research test flying may lie a chance to return to the staff of the School, or to fill an exchange appointment overseas or a chance to work with industry.

ETPS, the first in the business of formal test flying training, has graduated over 1,200 test pilots and flight test engineers to over 30 nations around the world. From the scores of first flights on exciting new technology types to the US space programme, graduates have forged the past and the future of modern, professional test flying. From its own graduation through a half-century of testing, the ETPS looks forward to the next 50 years remaining as leader of those very special institutions 'training to test'.

Right: *1991 ETPS fleet photograph showing Tornado F2, Gazelle HT3, Scout AH1, Hawk T1, Lynx AH7, Jet Provost T5, Jaguar T2, Basset CC2, Hunter T7, BAe 1-11, Sea King Mk4, and Andover C1 seen on the apron at Boscombe Down.*

Below: *The extensively modified cockpit of Hawk T1 ASTRA XX341.*



Left: *Andover C1 XS606 is used for STOL operations, auto-pilot and single engine exercises.*

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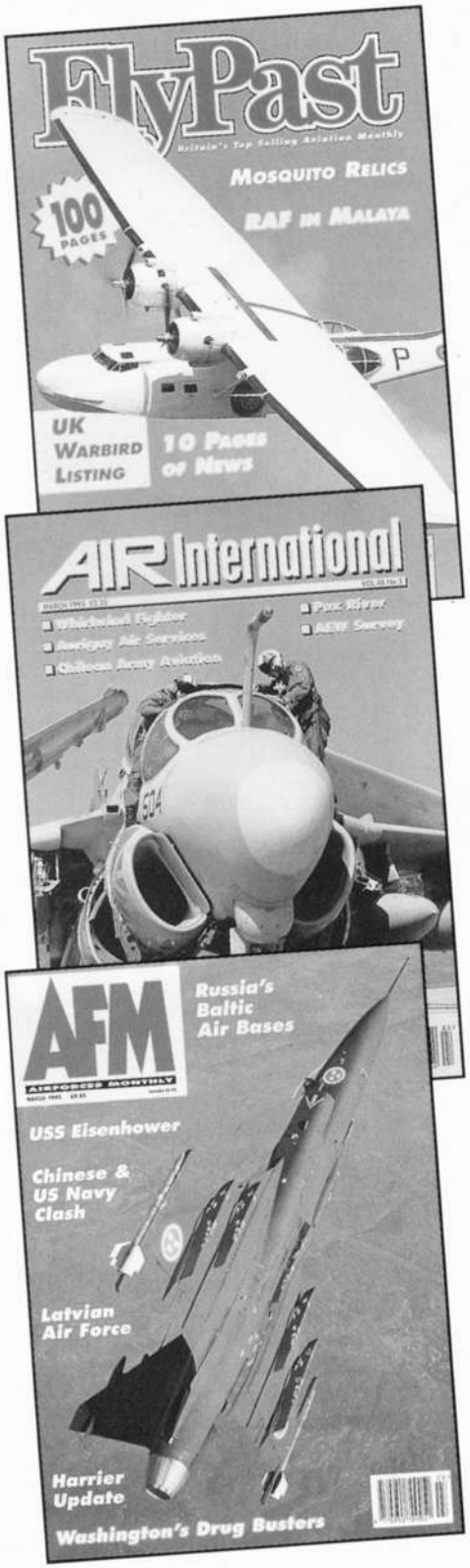

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AT THE TIME OF VICTORY

Michael J F Bowyer

looks at the strength of the Royal Air Force on VE-Day

Third generation Spitfires of the Mk XX series entered squadron service at the start of 1945, but the Mk 22 in the foreground was too late to see action.

It was a sunny, blustery, clear May day, exuding a feeling that it was fine to be alive. This was *the* most memorable Monday for millions of people – 7 May 1945. Shortly before 2.00am the German Government had, at General Eisenhower's HQ near Rheims, agreed to the unconditional surrender which brought an end to the war in north-west Europe. Flying operations over land ceased at 8.00am the next day, while at sea RAF Coastal Command and the Royal Navy continued to search for fleeing German shipping.

Bomber Command's heavies operated for the last time on 25 April, leaving it to 126 Mosquitos of 8 Group's Fast Night Striking Force to attack what was left of the German Navy in Kiel on 2/3 May and carry out the last bombing raid of the war. Including the 100 Group bomber support, 303 aircraft were active that final night, and as if to emphasise the fearful price of victory, three failed to return.

The war had witnessed an enormous increase in the size of the RAF, which had an operational strength of some 2,600 aircraft and 173,958 personnel at the start of September 1939. By VE-Day the latter numbered some 1,079,835 including many from overseas and of whom 193,313 were aircrew ready to man some 9,200 operational aircraft. Backing them all was a dedicated work force, that produced and sustained over 100,000 British-built combat aircraft during those years of war. On 28 April 1945, the closest census to VE-Day taken of RAF aircraft stocks world wide, showed a holding of 25,381 combat aircraft, of which 17,667 were in north-west Europe. Here a further 1,342 were in civilian or Ministry of Aircraft Production hands. Of the others, 2,116 were in the Mediterranean region and 1,665 within South-East Asia Command.

Between 3 September 1939 and the cessation of hostilities on 14 August 1945, 70,253 aircrew members of the RAF (including those from the Dominions, Empire countries and the Allies) were listed as killed or missing during operations; 47,293 of them serving with Bomber Command. Many more suffered from ordeals in prison camps and as a result of flying accidents. Making the overall operational effort possible there were, by late May 1945, over 886,000 men and 188,909 WAAFs serving in a wide array of ground trades.

Enormous strides had been made in respect of aircraft, weapons and electronics. Instead of repeatedly introducing new types, considerable effort was devoted to exploiting existing, tried designs enabling ever faster and much superior Spitfires, for example, to remain in post-war front-line use into the 1950s. When the war ended jet aircraft were still a novelty. As the accompanying listing shows, only 28 Meteors were in squadron hands, partly because excellent and reliable piston-engined aircraft were available. Fighting, which had steadily moved to higher altitudes in 1942, suddenly switched to low-levels and the fighter-bomber emerged as a most effective weapon. It was in use in considerable numbers at the end of hostilities in Europe. In that role the Hawker Typhoon in particular found its niche. Yet by mid-September 1945, with their immediate task completed, the 18 Typhoon squadrons of May had rapidly fallen to a mere three – Nos 175, 181 and 182 – and their numbers had fallen from 318 to just 48 aircraft.

Even before the fighting ceased some once familiar shapes had all but disappeared, an early casualty being the Handley Page Hampden. Other old friends managed to serve in the squadrons to the very end, among them the latest maritime Wellingtons, the superlative Sunderland and of course the Hurricane. Many aged second-line types remained active in Britain, including 37 Blenheims, 59 Beauforts and 43 Whitleys, along with most of the Tiger Moths still active and which therefore savoured the day of victory.

One of the most sudden changes when the war in Europe ended was that which overtook the Halifax force. These bombers, that had contributed so well, were immediately withdrawn from No 4 (Bomber) Group allowing their squadrons to be switched to Transport Command to support overseas operations. The No 6 Group Canadian squadrons fast dispersed too. Such Halifaxes as remained active served as general reconnaissance or transport aircraft pending the introduction of the C VIII dedicated transport. With a desperate need for many more transports Coastal Command's Liberator squadrons were also soon switched to Transport Command, in particular to return overseas troops to their home countries.

Rapid removal of Halifaxes left Lancasters arming the entire heavy bomber force. Although delivery of Avro Lincolns began in January 1945, and 35 were on RAF charge by VE-Day, none participated in operations. By the end of hostilities the Mosquito had become the most ubiquitous aircraft of the 1939-1945 war. Possibly its greatest contribution was to obtain superb photo coverage of Europe – and almost without loss. It proved, too, that fast unarmed aircraft could survive in hostile air space, thus pioneering the techniques later adopted for peacetime jet bombers.

Although the relief that the fighting in Europe was over penetrated everywhere, there was at first none of the widespread euphoria one might have expected, for too many sad memories abounded. Throughout the land those celebrations came the next day – **V**ictory in **E**urope **Day**. In my home town by midnight a huge pile of wooden Airspeed Oxford and Albemarle components, their contribution to victory completed, were quickly transformed into a heap of glowing ashes. A symbolic end to an unforgettable era.

RAF Frontline Strength – Metropolitan Air Force at 18.00hr on 6 May 1945

BOMBER COMMAND

Note: *Strength* **refers to number of aircraft serviceable;** *+ (plus)* **the number unserviceable.**

1) LANCASTER AND HALIFAX

No 1 Group established with 290 Lancasters Mk I/III

a) Squadrons each established with 20 Lancasters:

Squadron	*Base*	*Strength*
No 12	Wickenby	21 +1
No 100	Elsham Wolds	20 +1
No 103	Elsham Wolds	22
No 150	Hemswell	22 +1
No 153	Scampton	19
No 170	Hemswell	20 +1
No 300	Faldingworth	17 +2
No 625	Scampton	15 +3
No 626	Wickenby	21 +1

b) Squadrons each established with 30 Lancasters:

Squadron	*Base*	*Strength*
No 101	Ludford Magna	33 +2
No 166	Kirmington	32 +1
No 460	Binbrook	30 +7
No 550	N. Killingholme	32
No 576	Fiskerton	31 +2

Total Group strength: 335 +22 aircraft.

No 3 Group established with 290 Lancaster I/III

a) Squadrons established with 20 Lancasters:

Squadron	*Base*	*Strength*
No 15	Mildenhall	18 +6
No 90	Tuddenham	24 +2
No 138	Tuddenham	21 +1
No 622	Mildenhall	19 +3

b) Squadrons established with 30 Lancasters:

Squadron	*Base*	*Strength*
No 75	Mepal	29 +6
No 115	Witchford	31 +4
No 149	Methwold	28 +6
No 186	Stradishall	28 +6
No 195	Wratting Common	17 +17
No 218	Chedburgh	27 +2
No 514	Waterbeach	21 +9

Total Group strength: 263 +62 aircraft.

No 4 Group established with 220 Halifaxes

a) Halifax III – Only 3 squadrons (*) established with 20 aircraft; the remainder still holding:

Squadron	*Base*	*Strength*
No 10*	Melbourne	18 +3
No 51*	Leconfield	20
No 76	Holme-on-Spalding Moor	1
No 78	Breighton	20 +1
No 102	Pocklington	1
No 158	Lissett	24
No 346	Elvington	5
No 347	Elvington	2
No 466*	Driffield	23

b) Halifax Mk VI – each established with 20 aircraft:

Squadron	*Base*	*Strength*
No 76	Holme-on-Spalding Moor	21 +1
No 77	Full Sutton	18 +3
No 78	Breighton	19 +1
No 102	Pocklington	21 +1
No 158	Lissett	20
No 346	Elvington	18 +2
No 347	Elvington	20
No 640	Leconfield	20

Total Group strength : 271 +12 aircraft.

No 5 Group established with 350 Lancaster I/III and 20 Mosquitos

a) Squadrons each established with 20 Lancasters:

Squadron	*Base*	*Strength*
No 9	Bardney	20 +2
No 44	Spilsby	19 +3
No 49	Syerston	19 +2
No 50	Skellingthorpe	19 +1
No 57	East Kirkby	19 +2
No 61	Skellingthorpe	20 +2
No 83	Coningsby	19 +2
No 97	Coningsby	23
No 106	Metheringham	22 +2
No 189	Bardney	20 +3
No 207	Spilsby	20
No 463	Waddington	17 +3
No 467	Waddington	20 +1
No 619	Strubby	20 +2

b) No 617 Squadron established with 30 Lancasters, holding 25 +5 and based at Woodhall Spa, also had a Mosquito FB VI

c) No 627 Squadron established with 20 Mosquito Mks IV/XX/25 and holding: Mk IV – 9, Mk IX – 4, Mk XVI – 5+1, Mk XX – 0+3, Mk 25 – 4+2 and a Lancaster.

Total Group strength 365 +40 aircraft.

No 6 (RCAF) Group established with 348 Lancasters and Halifaxes.

a) Lancaster I/III squadrons each established with 20 aircraft:

Squadron	*Base*	*Strength*
No 424	Skipton-on-Swale	21 +1
No 427	Leeming	18 +4
No 429	Leeming	23
No 433	Skipton-on-Swale	22 +1

b) Lancaster X squadrons each established with 20 aircraft:

Squadron	*Base*	*Strength*
No 419	Middleton St George	18 +2
No 420	Tholthorpe	19 +1
No 425	Tholthorpe	10 +8
No 428	Middleton St George	17 +3
No 431	Croft	20
No 434	Croft	19 +1

c) Only No 415 Halifax III squadron established with 20; the four other squadrons still holding aircraft:

Squadron	*Base*	*Strength*
No 415	East Moor	15
No 420	Tholthorpe	10
No 425	Tholthorpe	20
No 429	Leeming	1
No 433	Skipton-on-Swale	1

d) Halifax VII squadrons established with 20 aircraft each:

Squadron	*Base*	*Strength*
No 408	Linton-on-Ouse	19 +1
No 426	Linton-on-Ouse	19 +1
No 432	East Moor	19 +2

e) No 415 Squadron also holding 5 Halifax VII

Total Group strength 296 +35 aircraft.

2) MOSQUITO BOMBERS

No 8 Group established with 240 Mosquitos:

Squadron	*Base*	*Variant*	*Strength*
No 105	Bourn	B XVI	22 +4
		B IX	5 +1
No 109	Little Staughton	B XVI	25 +4
		B IX	2 +1
No 128	Wyton	B XVI	17 +7
No 139	Upwood	B XX	4 +2
		B 25	1 +2
		B XVI	9 +6
No 142	Gransden Lodge	B 25	18 +2
No 162	Bourn	B 25	16 +3
		B XX	2
No 163	Wyton	B 25	19 +1
No 571	Oakington	B XVI	19 +4
No 68	Downham Market	B XVI	17 +1
		B 25	0 +2
		B XX	0 +2
No 692	Graveley	B XVI	4 +6

Mosquito bomber strength – 10 Squadrons, 223 + 54 aircraft.

No 1409 Met Flt (established with 7 PR XVI)			
	Wyton (8 Group)	PR XVI	5
		B IX	1

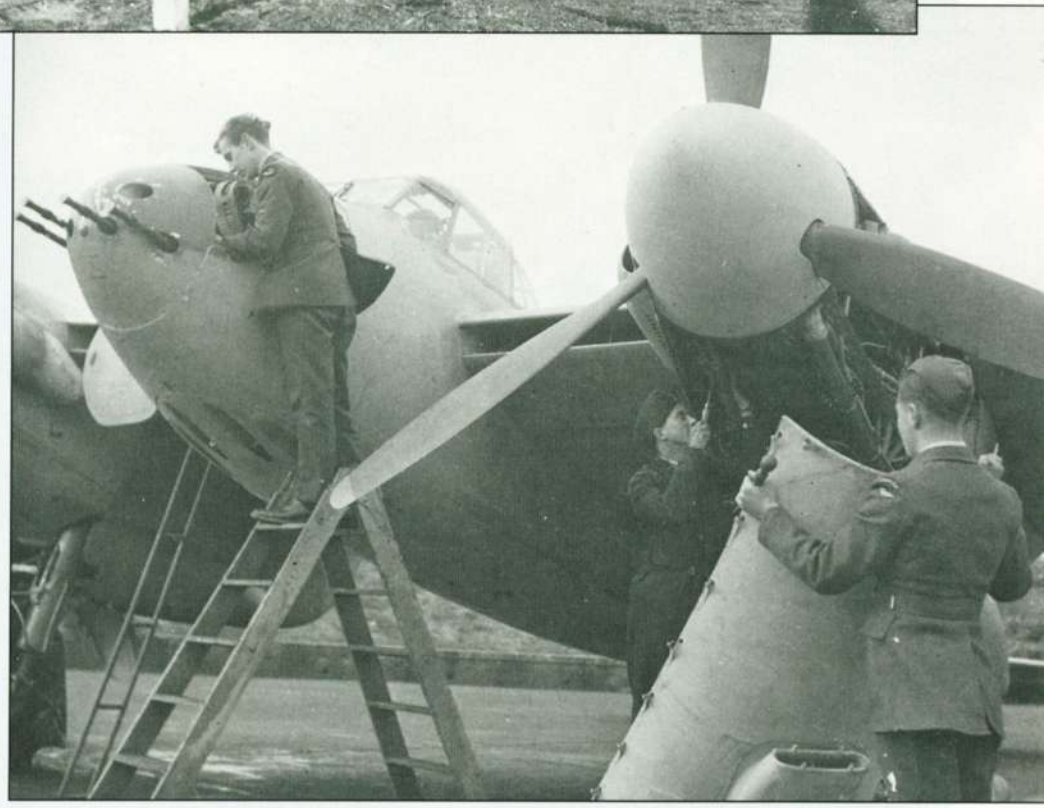
Below: *Very soon after the war ended, RAF operational aircraft carried their serial numbers boldly beneath the mainplanes, to discourage low-level flying celebrations. Displaying them, and yellow outlining to its squadron letters, is Lancaster ND974 of No 75 (New Zealand) Squadron.*

Below: *Mosquito XVIs of the Fast Night Striking Force, like these of No 692 Squadron at Graveley, created mayhem for the German defences.*

No 100 (Bomber Support) Group
Total establishment 254 aircraft:

Squadron	*Base*	*Establishment*	*Strength*
Fortress III			
No 214	Oulton	20	16 +4
No 223	Oulton	16	9 +2
Halifax III			
No 171	North Creake	24	20 +5
No 192	Foulsham	17	18 +1
No 199	North Creake	24	19 +4
No 462	Foulsham	20	28 +2
Liberator B VI			
No 223	Oulton	nil	16 +1
Mosquito IV			
No 192	Foulsham	nil	1
Mosquito FB VI			
No 23	Little Snoring	18	14 +5
No 141	West Raynham	nil	2 +1
No 157	Swannington	nil	1
No 169	Great Massingham	nil	3
No 515	Little Snoring	nil	15 +4
Mosquito PR XVI			
No 192	Foulsham	7	7 +1
Mosquito NF XIX			
No 157	Swannington	nil	3 +1
No 169	Great Massingham	18	14 +6
No 515	Little Snoring	18	nil
Mosquito NF 30			
No 85	Swannington	18	16 +3
No 141	West Raynham	18	14 +4
No 157	Swannington	18	9 +5
No 169	Great Massingham	nil	1 +4
No 239	West Raynham	18	16 +2

'nil' indicates no establishment remaining for that version



Top: *The speed of the Halifax's withdrawal from much of Bomber Command seemed quite sensational at the time. Survivors included the Free French squadrons including No 347, one of whose Mk IIIs is shown.*

Above: *By day and night Mosquito FB VI fighter-bombers carried out interdictor operations, only made possible by continuous efforts of their ground crews.*

Above: *Avro Lancasters had become a prominent feature of British life by 1945 and few places went without their daily passing-by.*

FIGHTER COMMAND

Squadrons
– established with 18 aircraft unless marked *

Squadron	*Base*	*Strength*
Spitfire F IX		
No 310	Manston	15 +2
No 312	Manston	13 +5
No 441*	Digby	14 +4
Spitfire LF IX		
No 1*	Coltishall	15 +4
Spitfire HF IX		
No 313	Manston	17 +3
No 329*	Skeabrae	1
Spitfire HF IXe		
No 124	Hutton Cranswick	19 +4
No 329*	Skeabrae	12 +8
No 504*	Colerne	nil +1
Spitfire LF IXe		
No 331	Dyce	6 +3
No 332	Dyce	7 +2
Spitfire LF XVI		
No 451	Lympne	16 +4
No 453	Lympne	15 +4
No 602	Coltishall	15 +7
No 603	Coltishall	18 +3
Spitfire F21		
No 1	Coltishall	2 +2
No 91	Ludham	16 +2
Meteor F III		
No 504	Colerne	9 +7
Mosquito NF 30		
No 25	Castle Camps	18 +2
No 29	Colerne	16 +2
No 125	Church Fenton	16 +2
No 151	Bradwell Bay	15 +5
No 307	Castle Camps	18 +3
No 406	Manston	15 +3
No 456	Bradwell Bay	11 +7
Mustang I		
No 26	Harrowbeer	17 +3
Mustang III		
No 19*	Peterhead	nil +4
No 64	Bentwaters	15 +3
No 65*	Andrews Field	8 +3
No 118	Bentwaters	13 +4
No 126	Bentwaters	17 +1
No 129	Bentwaters	16 +2
No 165	Bentwaters	14 +4
No 306	Coltishall	16 +1
No 309	Andrews Field	13 +2
No 315	Andrews Field	15 +1
No 316	Andrews Field	17 +1

Mustang IV

Squadron	*Base*	*Strength*
No 19	Peterhead	12 +2
No 65	Andrews Field	3 +4
No 122	Peterhead	15 +1
No 234	Peterhead	14 +2
No 303	Andrews Field	16 +1
No 441	Digby	nil
No 442	Digby	16 +2
No 611	Hunsdon	17 +1
Auster AOP IV/V		
No 666	Andover	13 +3

No 38 Group (Airborne Forces)
Squadrons administered by Fighter Command, established with 24 aircraft:

Squadron	*Mark*	*Base*	*Strength*
Halifax A III/VII			
No 190	Mk III	Great Dunmow	1
No 296	Mk III	Earl's Colne	27 +4
No 297	Mk III	Earl's Colne	28 +3
No 298	Mk III	Tarrant Rushton	17 +5
No 298	Mk VII	Tarrant Rushton	8
No 620	Mk III	Great Dunmow	0 +2
No 644	Mk III	Tarrant Rushton	11 +6
No 644	Mk VII	Tarrant Rushton	15

Stirling IV

Squadron	*Base*	*Strength*
No 190	Great Dunmow	22 +8
No 196	Shepherd's Grove	27 +5
No 295	Rivenhall	26 +5
No 299	Shepherd's Grove	26 +4
No 570	Rivenhall	26 +3
No 620	Great Dunmow	27 +3

Special Duties: No 161 Squadron, Tempsford

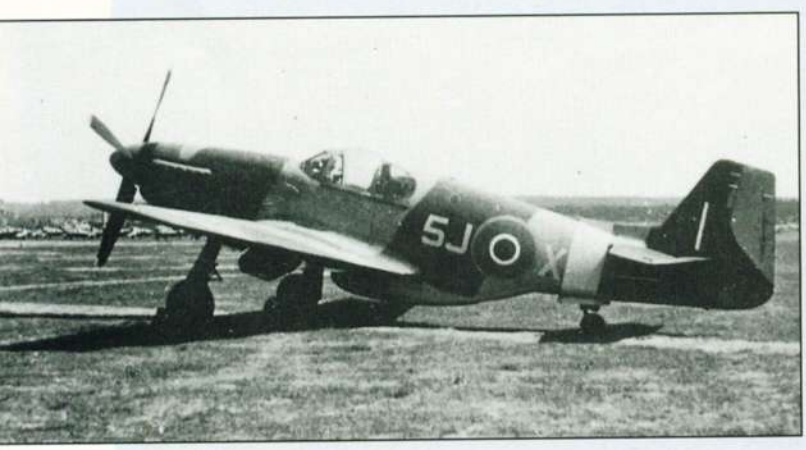
Stirling IV (estab 6)	10 +2
Hudson III/IIIa (estab 6)	5 +1
Lysander (estab 3)	3

No 1 Heavy Glider Servicing Unit at various bases:

Type	*Strength*
Dakota (estab 6)	5 +1
Horsa (estab 820)	587 +90
Hamilcar (estab 100)	57 +7
Hadrian (nil)	2

Below left: *Mustang IIIs like '5J-X' and Mk IVs were both in use as long-range escort fighters.*

Below: *Increasingly prominent operationally as the war was ending was the Tempest V – in this instance of No 486 (New Zealand) Squadron.*



Above: *Photographed in Denmark in May 1945, rocket-firing Typhoons of No 137 Squadron.*

Left: *Many Spitfire IXs – including those of No 401 (Canadian) Squadron – remained very active in 1945, some bearing 'invasion stripes' to the end of hostilities.*

2ND TACTICAL AIR FORCE
Mitchell and Mosquito FB VI squadrons established with 20 aircraft each. Others, unless noted, were established with 18 aircraft each:

Squadron	*Mark*	*Base*	*Strength*
Mitchell:			
No 98	Mk II	Achmer	1 +1
	Mk III		16 +3
No 180	Mk II	Achmer	2
	Mk III		16 +3
No 226	Mk II	Gilze-Rijen	2
	Mk III		16 +3
No 320	Mk II	Achmer	10 +1
	Mk III		6 +3
No 342	Mk II	Gilze-Rijen	2 +1
	Mk III		13 +4

Squadron	*Base*	*Strength*
Mosquito FB VI:		
No 21	Melsbroek	18 +1
No 107	Epinoy	18
No 305	Epinoy	19
No 418	Volkel	18 +1
No 464	Melsbroek	16 +4
No 487	Melsbroek	15 +2
No 605	Volkel	15 +1
No 613	Epinoy	16 +3
Spitfire LF IX:		
No 317	Varrelbusch	17 +1
No 401	Wunstorf	13 +3
Spitfire LF IXe:		
No 349	Varrelbusch	17 +2
No 411	Wunstorf	15 +2
No 412	Wunstorf	10 +8
No 485	Drope	20
Spitfire XIV:		
No 350	Fassberg	11 +3
Spitfire XIVe:		
No 41	Celle	17 +1
No 130	Celle	12 +1
No 402	Wunstorf	16 +1

Squadron	*Base*	*Strength*
Spitfire LF XVI:		
No 74	Drope	21
No 302	Varrelbusch	19
No 308	Fairwood	19
No 322	Varrelbusch	17 +3
No 340	Drope	17 +2
No 341	Drope	18 +1
No 345	Drope	20 +2
No 403	Soltau	18
No 416	Soltau	13 +5
No 421	Reinsehlen	15 +3
No 443	Schneverdingen	17 +2
Tempest V:		
No 3	Fassberg	15 + 0
No 33	Quackenbruck	12 +2
No 56	Fassberg	15 +2
No 222	Quackenbruck	12 +2
No 486	Fassberg	11 +5
Tempest V (fighter-bomber):		
No 80	Warmwell APC	19
No 274	Quackenbruck	16 +1
Spitfire FR XIV (LR):		
No 268	Twente	13 +4
No 414	Reinsehlen	17 +0
Spitfire FR XIVe:		
No 2	Twente	18 +2
No 430	Reinsehlen	10 +1
Mosquito NF XIII:		
No 219	Gilze Rijen	3
No 264	Rheine	20 +2
No 409	Gilze Rijen	18 +3
Mosquito NF 30:		
No 219	Gilze Rijen	15 +3
No 410	Gilze Rijen	14 +4
Meteor III:		
No 616	Luneburg	12
Mustang Ia, II:		
No 268	Twente	2 (Mk Ia)
		6 +1 (Mk II)

Squadron	*Base*	*Strength*
Typhoon 1b:		
No 137	Luneburg	16
No 164	Plantlunne	17 +1
No 175	Hustedt	17 +1
No 181	Luneburg	15 +1
No 182	Luneburg	16 +1
No 183	Wunstorf	19 +1
No 184	Hustedt	15 +2
No 193	Ahlhorn	19 +1
No 197	Ahlhorn	15 +1
No 198	Plantlunne	16 +2
No 245	Celle	16 +1
No 247	Lubeck	16 +2
No 263	Ahlhorn	15 +3
No 266	Fairwood APC	15 +3
No 438	Celle	16 +2
No 439	Celle	16 +2
No 440	Warmwell APC	15 +2
No 609	Plantlunne	17 +1
Spitfire PR XI:		
No 4	Twente	14 +3
No 16	Eindhoven	14 +3
No 400	Reinsehlen	18 +1
Spitfire PR XIX:		
No 16	Eindhoven	4 +1
Mosquito PR XVI:		
No 140	Eindhoven	15 +5
Wellington GR XIII:		
No 69	Eindhoven	12 +5
No 276 ASR Squadron at Knocke-le-Zoute		
Spitfire V (estab with 7)		6 +1
Walrus (estab with 6)		3 +3
Sea Otter		nil
Also administered :		
No 1401 Met Flt		
Spitfire HF IX 4 +2		
Auster IV/V Squadrons established with 16)		
Squadron	*Strength*	
No 652	14 +1	
No 653	15	
No 657	14 +2	
No 658	15	
No 659	15	
No 660	13 +1	
No 661	17	
No 662	11 +2	
No 664	15 +2	
No 665	15 +1	

COASTAL COMMAND

Long range reconnaissance

Liberator (squadrons established with 15 aircraft):

Squadron	*Mark*	*Base*	*Strength*
No 53	Mk VIII	Reykjavik	7 +8
No 59	Mk VIII	Ballykelly	12 +3
No 86	Mk VIII	Tain	9 +6
	Mk V	Tain	0 +1
No 120	Mk VIII	Ballykelly	14 +1
No 206	Mk VIII	Leuchars	6 +7
	Mk VI	Leuchars	0 +1
No 220	Mk VI	Lagens	13 +2
No 224	Mk VIII	Milltown	9 +8
No 311	Mk VI	Tain	7 +7
No 547	Mk VIII	Leuchars	5 +7
	Mk VI	Leuchars	2 +6

Halifax (squadrons established with 15)

No 58	GR III	Stornoway	6 +3
	GR II	Stornoway	1 +3
No 502	GR III	Stornoway	11 +3

Medium range reconnaissance

Squadron	*Base*	*Strength*
Warwick GR V (established with 15):		
No 179	St Eval	5 +12

Wellington GR XIV (established with 15 except where marked * with 20)

No 14	Chivenor	12 +3
No 36	Benbecula	9 +8
No 172	Limavady	8 +11
No 304	St Eval	6 +10
No 407	Chivenor	12 +4
No 524	Langham	16 +5*
No 612	Langham	11 +5
Swordfish Mk III (established with 15)		
No 119	Knocke/Le Zoute	10 +6

Torpedo Fighter

Beaufighter TF X (established with 20):

No 254	North Coates	10 +4
No 489	Dallachy	9 +10

Coastal Fighter

Beaufighter TF X (established with 20):

No 144	Dallachy	12 +8
No 236	North Coates	11 +13
No 455	Dallachy	8 +10

Mosquito FB VI (established with 20):

No 143	Banff	15 +3
No 235	Banff	10 +8
No 248	Banff	14 +4
No 404	Dallachy	16 +4

Mosquito FB XVIII

No 254	North Coates	1 +1

Flying Boats

Catalina IV (established with 12):

No 210	Sullom Voe	4 +8

Sunderland (established with 12):

No 10(RAAF)	Mount Batten	8 +4 (Mk III)
No 201	Castle Archdale	5 +4 (Mk III)
No 201	Castle Archdale	0 +1 (Mk V)
No 228	Pembroke Dock	10 +2 (Mk V)
No 330*	Sullom Voe	3 +5 (Mk V)
No 422	Castle Archdale	6 +1 (Mk III)
No 423	Castle Archdale	5 +3 (Mk III)
No 461	Pembroke Dock	12 +6 (Mk V)

* established with 9 Mk III/V

Mixed Catalina/Sunderland:

No 202	Castle Archdale	8 +0 Catalina IV 0 +8 Sunderland

Special reconnaissance:

No 333	Woodhaven Catalina IV (estab with 3)	3 +1
No 333	Woodhaven Mosquito FB VI (estab with 10)	7 +2

Photographic Reconnaissance

Mosquito (established with 18):

No 540	Coulommiers	0 +2 (PR 32) 9 +7 (PR XVI) 1 +1 (PR VI)
No 544	Benson	14 +2 (PR XVI) 3 +0 (PR 34) 2 +0 (PR VI)

Spitfire:

No 541	Benson	9 +5 (PR XI) 4 +0 (PR XIX) 2 +0 (PR X)
No 542	Benson	11 +2 (PR XI) 3 +1 (PR XIX) 3 +0 (PR X)

Mustang III:

No 541	Benson	1 +1

Air-Sea Rescue

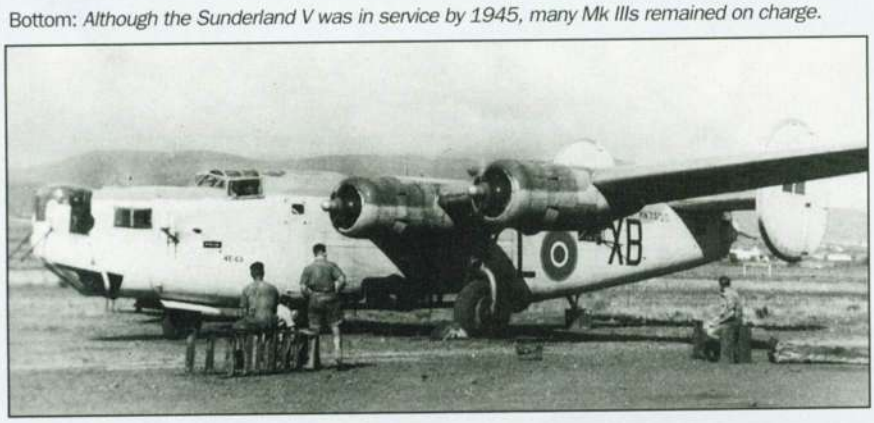
Squadron	*Base*	*Type*	*Strength*
No 251	Reykjavik	Warwick 1	0 +3
		Hudson IIIA	2 +1
No 269	Lagens	Warwick 1	2 +5
		Walrus	1
		Hudson III	2
No 278	Beccles	Walrus	12 +4
		Sea Otter	0 +3
No 279	Thornaby	Warwick 1	9 +12
		Hurricane II	7 +1
		Sea Otter	0 +8
No 280	Beccles	Warwick	7 +19
No 281	Limavady	Warwick	3 +11
		Sea Otter	0 +6
No 282	St Eval	Warwick	5 +4
		Walrus	2 +3
		Sea Otter	2 +6

Meteorological Reconnaissance

No 251	Reykjavik	Hudson III	1 +2
		Fortress II/IIA	0 +7
No 269	Lagens	Spitfire V	4 +1
No 517	Brawdy	Halifax V	4 +4
		Halifax III	4 +4
No 518	Tiree	Halifax V	6 +9
		Halifax III	9 +4
No 519	Wick	Fortress II/IIA	0 +11
		Spitfire VII	2 +1
No 521	Langham	Hurricane II	2 +3
		Fortress II/IIA	2 +2
No 1402 Met Flt	Manston	Hurricane II	2 +3
		Spitfire VII	3

Below: *At the end of the war Coastal Command long-range patrol squadrons were operating Liberator GR VIIIs like KN753/G of No 224 Squadron. Many were promptly converted into transports.*

Bottom: *Although the Sunderland V was in service by 1945, many Mk IIIs remained on charge.*



TRANSPORT COMMAND

Long range transport (established with 25):

No 46	Stoney Cross	Stirling V	13 +12
No 242	Stoney Cross	York	4 +1
		Stirling V	9 +7
		Wellington XVI	1
No 246	Holmsley South	York	9 +4
		Liberator C VII	2 +5
		Skymaster	2 +1
		Liberator III	3 +2
		Liberator VI	3
		Halifax III	1

Established with 23 York/Liberator VII and two C-54 Skymasters

No 511	Lyneham	York	12 +10

Medium range transport (established with 25):

No 24	Hendon	Dakota	18 +9
		Anson	4 +1
No 147	Croydon	Dakota	22 +5
		Anson	5
No 167	Blackbushe	Warwick 1/III	16 +18
		Anson XII	1 +4
No 187	Merryfield	Dakota	20 +7
		Halifax III	17 +5
No 525	Lyneham	Dakota	14 +12

Air Support (basically established with 25 Dakotas and 5 Ansons):

No 48	Down Ampney	Dakota	22 +3
		Anson	4 +1
No 233	Blakehill Farm	Dakota	19 +6
		Anson	3 +1
No 271	Down Ampney	Dakota	29 +2
		Harrow	1
No 437	Blakehill Farm	Dakota	19 +6
		Anson	1 +2
No 512	Broadwell/Evere	Dakota	21 +4
		Anson	4 +1
No 575	Broadwell	Dakota	19 +6
		Anson	3 +1

Metropolitan Communications Squadron, Hendon: Anson 7 +3, Auster V 2, Dakota 0 +1, Dominie 7 +4, Grumman Goose 1, Hudson III/A 1 +5, Hudson V 1, Hurricane IIc 0 +1, Koolhoven FK 46 1, Lockheed 12A 4 +1, Miles M.38 1, Monarch 1, Oxford 2 +1, Oxford Ambulance 0 +1, Proctor 27 +2 Spitfire V 0 +2.

JEFTS

Peter Underhill, private pilot and chairman of the Popular Flying Association, visits the civilian run Joint Elementary Flying Training School. Photography by **Keith Wilson**.

RAF Topcliffe, in the picturesque Vale of York, is home to an example of Government privatisation which is helping to reduce that part of the Defence Budget allocated to the training of RAF pilots and is hopefully saving the taxpayer some hundreds of thousands of pounds a year. The Joint Elementary Flight Training School (JEFTS) is run by Hunting Aviation, which as Hunting Aircraft, manufactured the Jet Provost T3/4 back in the late 1950s and early 1960s. It uses civilian Slingsby T67Ms and A-category ex-Service flying instructors to teach fledgling RAF, together with German and Royal Navy pilots their first 62 hours of flying training. What is most significant, however, is that the whole unit is indistinguishable from an RAF training station, with instructors and students wearing the standard UK issue military flying kit of green flying suits (known as 'grow-bags'), white kid leather gloves and bonedomes. As a result, JEFTS has managed to create that indefinable but all-pervading air of the professionalism one finds on every RAF operational base.

Perhaps the most important aspect of JEFTS is that, for a very cost-effective price of under £250 per flying hour, it is providing an equally high standard of military flying training and ground instruction for a fraction of the amortised hourly cost of an RAF Bulldog or of Middle Wallop's Army Air Corps Chipmunks.

The original EFTS contract (it became 'Joint' after the RN pilots began going through the course in 1994) was won by Hunting, who had teamed with Slingsby early in the competition, to bid with the Firefly and a military-style operation against a number of seemingly better-qualified civil flying training school heavyweights. British Aerospace proposed the Swiss Bravo and a more civilianised offering, CSE at Oxford tried to introduce the Zlin 242, Airwork tied up the Grob factory with a single company deal for the military version of the G115C and Lovaux came up with the Sprint version of the SAH-1. Hunting evaluated all of these aircraft (and more besides) before concluding that the T67M Mk2 Firefly met the specification, was in production, and had a proven pedigree.

Perhaps the most important aspect of JEFTS is that it is providing a high standard of military flying training and ground instruction at a very cost-effective price.

The contract was finally awarded early in February 1993, leaving just five months in which to achieve the phase-in plans. These included the recruitment of flying instructors and ground crew, setting up a Civil Aviation Authority approved M3 maintenance base, conversion training to the Firefly with CFS checks and a million and one other tasks. This all had to be completed before 8 July on an airfield which was busy running down its RN Bulldog courses. Life, according to Hunting's Military Business Director Bob McLuckie, was fairly difficult for a few months.

At the same time, Slingsby was gearing up to fulfil its major US order for the Firefly. Fortunately, Hunting had taken a calculated risk, some six months earlier, by obtaining five second-hand T67Ms that had been sitting idle at Cranfield. These were supplemented by four new Fireflies delivered to Topcliffe in July, thus allowing the first course to get under way, as planned, in July 1993. The remainder of the fleet was delivered in December, somewhat behind schedule. Today the flightline has 17 Fireflies and the training catchment has since expanded to include first British and later German Navy pilots. JEFTS currently runs up to three courses simultaneously, with a maximum of 22 student pilots on each.

Hunting effectively took over Topcliffe, even providing the Air Traffic Control services, although the airfield is still visited by Bulldogs from nearby Leeming, plus the occasional arrival from other RAF airfields. All flying activity in the very busy airspace of the Vale of York is centrally co-ordinated under the overall control of RAF Leeming. The Ops Room at Topcliffe is arguably one of the best equipped in the UK, while even the standard RAF 'feeder' catering unit behind the hangar has been retained to introduce future Service pilots into the military culture. The maintenance of the civilian-registered Firefly aircraft is carried out to CAA M3 standards in the immaculately clean hangar and any long-serving RAF pilot visiting Topcliffe would probably notice little difference from a former RAF operation.

Before bidding for the contract, Hunting recruited Wg Cdr Don Paton to research and produce the proposal and to begin sounding out potential instructors. This was mainly done by passing word around 'the network' and then holding screening seminars, for pilots up to Squadron Leader level (or the RN equivalent) who had been CFS trained Qualified Flying Instructors before going into commercial flying.

As a result, over half of the instructing strength was identified in advance of the final contract (for five years with a five-year option) being finally signed by the Ministry of Defence. With one exception (Heather Deacon, a very experienced and able civilian instructor) Hunting selected flying instructors whose original flying with the RAF, plus their subsequent civilian flying experience, enabled them to provide a much wider approach to teaching flying skill and airmanship. All are on a ten-year contract, as the original training contract specified that, even if it were to be awarded to someone other than Hunting after the initial five year term, the aircraft and staff went with the package.

When Slingsby began deliveries of its T67M to the USAF, three senior members of the JEFTS staff (David Wooldridge, Manager; Peter Thompson, Head of Training and Ian Hewitt, Training Standards officer) were seconded to Hondo in Texas to carry out the conversion training for the American instructors, all of whom were delighted with the Firefly and its superb flight handling characteristics.

Selection for a Service flying career follows the same route as before, with the RAF still putting hopeful military pilots through the rigorous selection and screening procedure at Cranwell. RAF student pilots can have anything between zero and 160 hours of flight experience behind them. Some will have secured an RAF Flying Scholarship with a civil flying club and others, having been through the University Air Squadron route, enjoying Bulldog flying time.

Prospective Royal Navy fixed- and rotary-wing pilots are first processed through the Navy's own civilian *ab initio* training contract that is operated by Shorts at Plymouth Airport,

Above: *The Slingsby T67M's uncluttered instrument panel and roomy cockpit.*

Main picture: *With operating costs under £250 per hour, the Firefly is making appreciable savings for the RAF's EFTS operation.*

flying Grob G115s and arrive at Topcliffe with around 15 hours experience. While some of the German Navy pilots also go through Plymouth, the remainder come direct from the Luftwaffe course in Germany. The irony of training both German and British military pilots together on a former WW2 Bomber Command OCU airfield cannot have escaped the notice of the locals.

The actual flying syllabus follows traditional RAF lines. The early hours comprise basic flying skills, to enable the student to experience that all-important confidence-building first solo flight, normally after about ten hours dual. Thereafter, the next ten hours introduce students to basic aerobatics (including spinning) and include an aerobatics test followed by a further 15 hours of advanced handling and more aerobatics. At this stage, the students are introduced to instrument flying, including PAR (Precision Approach Radar) techniques, while the final part of the course teaches formation flying and navigation, with high-, mixed-profile and low-level navigation conducted both dual and solo. As JEFTS is a civilian operation, students are restricted to a minimum height of 500ft agl, so much of the low-level work is carried out over the sparsely populated Vale of York.

Having completed the course to the satisfaction of their instructors, RAF/RN Standard QFIs and the Head of Training Peter Thompson, the RAF pilots then progress to the RAF-operated Tucano, transferring either to the RAF College Cranwell or No 1 Flying Training School at RAF Linton-on-Ouse. Royal Navy pilots (unless selected to fly the Sea Harrier) move to helicopter training at RNAS Culdrose. Prospective Sea Harrier pilots also join the RAF Tucano course before proceeding on to the Hawk at RAF Valley.

It is privately acknowledged that the contracting-out of flying training to a civilian contractor originally went very much 'against the grain' in some RAF circles, where the traditional approach was much preferred. After less than a year in operation, the system was shown to be working well and cost effectively and now, after almost two years, those same detractors are considerably happier with the situation. Perhaps an indication of this can be judged by the planned move of JEFTS to the RAF College, with its flight operations at Cranwell's satellite airfield, Barkston Heath.

Whatever future plans the Ministry of Defence has for the JEFTS, in terms of value for money, the case against it is almost impossible to argue. The question must be contemplated, however, just how much wider can the privatisation of military activities, especially those of the Royal Air Force, extend, and whether all such operations will result in quite such dramatic financial savings as have been achieved by the Joint Elementary Flight Training School?

The **Pilot's Perspective** Collection

TL/010

TL/009

Whispering Death, **the latest addition to The Pilot's Perspective Collection by Birmingham artist Trevor Lay. Loud, fast and low; a Beaufighter banks hard over a tranquil Burmese river shortly before the end of the Second World War.**

Trevor Lay's remarkable Collection now consists of ten breathtaking compositions showing *warbirds of prey* from a Pilot's Perspective.

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THE RAF's YEAR 1994

Above: *In December, Harrier GR7s based at Incirlik, Turkey, reached 5,000 flying hours in support of Operation* Warden. BAe

Brian Strickland

reviews some of the highlights of 1994

JANUARY

• On 7 January ten **Tornado GR1s** of No 12 Squadron left RAF **Marham** on transfer to RAF **Lossiemouth**, where the unit formed half of the former Buccaneer maritime strike/attack force.

• Under the Ground Training Review the Airmen's Command School (ACS) closed at RAF **Hereford** and moved to RAF **Halton**.

• **No 14 Squadron** based at **RAF Brüggen** was designated the TIALD target marking squadron, replacing No 617 Squadron. The TIALD day/night laser-designator pod was first used in the Gulf War.

• Two women pilots made history at **RAF Finningley** by being the first all-female crew to take an RAF **Jetstream** of No 45(R) Sqn on a training sortie.

• A **Harrier GR7** based at Incirlik AB in Turkey on Operation *Warden* had an engine failure during a routine patrol over Northern Iraq. The pilot was quickly rescued by a US helicopter – and the local Kurdish guerrillas secured the wreckage until an RAF salvage team could remove it.

• Hughes Rediffusion Simulation won a multi-million pound contract to supply the Ministry of Defence with a search and rescue simulator, to be delivered to RAF **St Mawgan** in February 1996.

• The MoD awarded GEC-Marconi Avionics a multi-million pound contract for the supply of additional TIALD pods to equip RAF **Jaguars**.

• On 18 January the first intake to undergo recruit training since the School of Recruitment Training moved from **Swinderby**, held its passing out parade at RAF **Halton**.

FINAL PHANTOM RETIREMENT

Daniel March

The UK's last airworthy **Phantom FGR1** XT597 was retired on 31 January, following its use by **A&AEE Boscombe Down** as a calibration chase aircraft.

FEBRUARY

• On 1 February RAF **Honington** ceased to be a regular flying base when the **Tornado GR1As** of No 13 Squadron moved to RAF **Marham**. The TWCU – No 15(R) Squadron had already relocated to RAF Lossiemouth.

Allocation of upgraded **Chinook HC2s** to bases other than RAF **Odiham** began on 1 February when ZA714 was issued to No 18 Squadron at RAF **Laarbruch**. A few days before HC2 ZA710 began the long sea journey to No 78 Squadron at RAF **Mount Pleasant**, Falkland Islands.

Patrick Allen

• The first **Tornado GR1B** with an interim capability of launching the BAe *Sea Eagle* anti-shipping missile was delivered, after modification at RAF **St Athan**, to No 617 Squadron at RAF **Marham**.

• A £23 million order from the MoD to supply long range air defence radars to the RAF was announced by Siemens Plessey Systems. The order was for three AR327 tactical mobile radars and covers the provision of long-term support. All elements are air transportable, by either a **Hercules** or underslung from a helicopter.

• After nearly 80 years service **No 23 Squadron**, one of the RAF's oldest fighter squadrons, was disbanded at RAF **Leeming** on 26 February, following the *Options for Change* review. Its **Tornado F3s** were reallocated to other air defence squadrons.

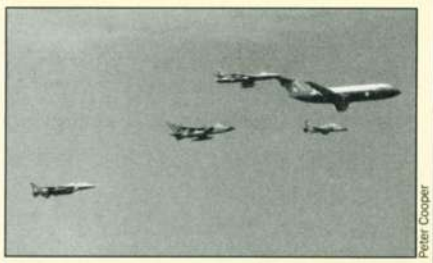
MARCH

• On 9 March the last RAF Regiment Basic Gunners' Course passed out at RAF **Catterick**, prior to its closure.

• An agreement was announced on 21 March that 24 RAF **Tornado F3s** were to be leased to the Italian Air Force 'for a period of up to ten years'.

• Between 4-20 March Exercise *Arctic Express* was held at Bardufoss and Bodo in Northern Norway. RAF **Harrier, Jaguar** and **Tornado GR1A** aircraft took part in severe weather conditions.

DRA **Farnborough** ceased flying on 25 March and commenced its move to **Boscombe Down.** On the previous day a final flypast of five aircraft – **BAC 1-11, Jaguar, Hawk, Tornado** and **Hunter** was made.



Peter Cooper

• On 23 March the **Rapier** Field Standard C low-level air defence system was demonstrated for the first time at RAF **Laarbruch**, the base of No 26 Squadron RAF Regiment.

• The RAF Headquarters and accommodation at **West Drayton**, the London Air Traffic Control Centre, closed after 60 years' service. The closure was part of the North West London Project, started five years ago to rationalise the forces' land holdings.

MARITIME TORNADO

PRM

On 27 April No 617 Squadron, equipped with **Tornado GR1/1B** strike/attack aircraft, left RAF **Marham** to join No 12 Squadron at RAF **Lossiemouth**, to assume the anti-shipping role in place of No 208 Squadron's Buccaneers.

APRIL

• The first course of Electronic Mechanics passed out from No 1 Radio School, RAF **Locking**, after 30 weeks training.

• On 1 April the RAF **Institute of Aviation Medicine** at Farnborough began a two year programme of integration within the DRA, which is forming a new Human Factors establishment, incorporating similar branches of the Army and Navy. The IAM operates **Hawk T1** XX327 and XX165.

• Full integration of women into the Royal Air Force took place on 1 April, and the title Women's Royal Air Force and the post of Director were disestablished.

• Two new RAF Commands were established on 1 April – Personnel and Training Command at RAF **Innsworth** and Logistics Command at RAF **Brampton**, replacing the former RAF Support Command.

On 6 April the BAe constructed British prototype of the **Eurofighter 2000** made its first flight at Warton. The next day the **BAe Harrier T10** was airborne for the first time at the same airfield.

BAe

MAY

• The Government of Belize was presented with **Harrier GR3** ZD669, formerly of No 1417 Flight, as a gate guardian at the International Airport, as a symbol of the close association between the RAF and Belize.

BUCCANEER BOWS OUT

The **Buccaneer S2B** came to the end of 25 years of service with the RAF at the end of March. On the weekend of 26-27 March over 1,000 ex-Buccaneer aircrews and ground crews assembled at RAF **Lossiemouth** to mark the occasion. The highlight of the occasion was a display by nine Buccaneers, led by OC No 208 Squadron.

Gordon Bartley photographs

• A new era began for the RAF School of Fighter Control at **Boulmer**, when the Duchess of Northumberland opened the Dowding Centre for Air Defence Battle Management Training.

JUNE

• On 2 June all four crew and 25 passengers aboard a **Chinook HC2** en-route from Northern Ireland to Inverness lost their lives when their helicopter crashed into a mountainside near the Mull of Kintyre.

• Twelve RAF **Hercules** from Nos 47 and 70 Squadrons at RAF **Lyneham** carried nearly 1,000 paratroops to be dropped on Pegasus Bridge in Normandy on 5 June. The BBMF's **Dakota** dropped senior British officers into Ranville at the same time.

• Also on 5 June, Strike Command contributed 19 aircraft to the mass flypast over Portsmouth as part of the D-Day commemorations. The formation then passed over Weymouth, Torbay and Plymouth before returning to its temporary base at Yeovilton.

• The 75th Anniversary of the formation of No 1 Flying Training School at **Netheravon** was celebrated at RAF **Linton-on-Ouse**, its present base. Since its formation more than 7,000 pilots have received their pilot training at No 1 FTS.

• On 30 June the Berlin Station Flight at **Gatow** was disbanded and its two **Chipmunk T10s** withdrawn.

• The RAF ensign was lowered at RAF **Catterick** for the last time on 30 June. The RAF Regiment Depot transferred to RAF **Honington**.

• Air Chief Marshal Sir Richard Johns became Air Officer Commanding-in-Chief Strike Command and Commander Allied Air Forces North Western Europe on 30 June in succession to the late Air Chief Marshal Sir John Thomson.

JULY

• A major new NATO command headquarters was opened at **High Wycombe** on 1 July. Named HQ Allied Forces North Western Europe (AFNORTHWEST) the new HQ would, in wartime, command a wide range of national and international defence formations.

On 1 July 'A' Flight of No 22 Squadron at RAF **Chivenor** received two **Sea King HAR3** helicopters to replace its Wessex HC2s.

Peter Cooper

• The RAF ensign was lowered for the last time at Devil's Tower Camp, **Gibraltar** on 9 July signifying the end of 52 years RAF command. RAF Gibraltar is now confined to two areas on the airfield – North and South dispersals.

• The airlift by the UN High Commission for Refugees to Sarajevo passed a significant milestone on 12 July when an RAF **Hercules** made the 10,000th humanitarian aid flight.

• After 30 years of helicopter Search and Rescue operations by Whirlwind, Wessex and Sea Kings at RAF **Coltishall**, No 22 Sqn B Flight moved to **Wattisham** on 21 July.

OPERATION DENY FLIGHT


RAF Leeming

On 23 July the 5,000th flying hour by **Tornado** F3s in support of Operation *Deny Flight* was achieved.

• The **Pumas** of No 1563 Flight, **Belize** ceased flying on 31 July, after 16 years of operational service in Central America. It also marked the closure of the RAF's last operational unit in Belize.

AUGUST

Special permission was given to paint BBMF **Spitfire IIA** P7350 as 'Enniskillen' RN-S of **No 72 Squadron**, one of the 17 Spitfires presented to the RAF by the people of Northern Ireland during WW2.

PRM

• A major contract was awarded to Smiths Industries Aerospace to supply an Integrated Navigation System for up-grading 30 RAF **Hercules** – half of the current fleet.

• The RAF participated in trials to evaluate the inter operability of forces employing new data link technology, the Joint Tactical Information Distribution System (JTIDS), in Idaho, USA. A three week trial with the USAF was code named *Trial Kairine*.

• For the first time, the RAF took part in US Army's Exercise *Air Warrior*. **Harrier GR7s** from Nos 1, 3 and 4 Squadrons used the facilities at Nellis AFB, NV and the National Training Centre at Fort Irwin, CA.

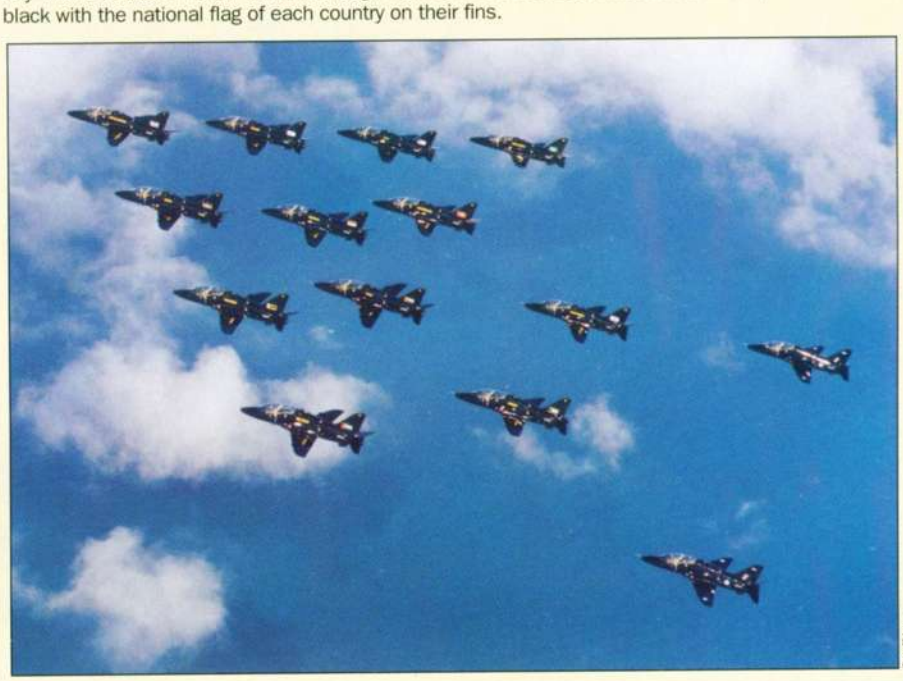
SEPTEMBER

• **RAF Gatow** was finally handed over to the Luftwaffe on 7 September when the RAF Ensign was lowered for the last time. **Gatow** was taken over by the RAF Regiment from the Russians in 1945.

• A **Sentry AEW1** of No 8 Squadron, returned to **RAF Waddington** on 9 September after completing the 1,000th sortie by the E-3D component in support of Operation *Deny Flight* over former Yugoslavia.

HAWK CELEBRATION

The OC of the CFS **Hawk** Squadron at RAF **Valley** led a formation of 14 Hawks, flown on behalf of British Aerospace to represent the number of countries to which the **Hawk** has been sold, on each day of the SBAC air show at Farnborough from 5-11 September. The **Hawks** were painted all over black with the national flag of each country on their fins.


Geoff Lee

•On 17 September RAF aircraft dropped some 720 paratroopers in Holland to commemorate the 50th anniversary of Operation *Market Garden*, the Battle of Arnhem.

•The former airfield at **RAF Bentwaters** hosted the RAF exercise *Hazel Flute* between 19-30 September. Some 22 RAF **Harrier GR7s** took part, preparing the **Harrier** crews for their role within NATO's Reaction Forces (Air) from 1995. Aircraft were drawn from No 1 Squadron at **RAF Wittering** and Nos 3 and 4 Squadrons at **RAF Laarbruch.**

•On 22 September two RAF **Jaguars** were called into action in Bosnia. A retaliatory attack involved the **Jaguars** each dropping a 1,000lb bomb on a Bosnian Serb 155 tank which had entered the Sarajevo heavy weapons exclusion zone.

•The last flight of the DRA's **Buccaneer S2B** XV344 took place on 28 September.

• **No 7 FTS** (formerly No 2 Tactical Weapons Unit) at **RAF Chivenor** closed on 30 September. Its advanced flying training role was passed to No 4 FTS at RAF Valley.

•The RAF sold four **HS125 CC1s** that had been operated by No 32 Squadron at **RAF Northolt**, to an American buyer.

• It was announced that The Joint Elementary Flying Training School (JEFTS) will move from **Topcliffe** to **Barkston Heath** in the Spring of 1995. It will continue to be operated by Hunting Aviation and equipped with 18 civil registered Slingsby T67M2 Fireflies.

OCTOBER

•**RAF Brize Norton** was briefly at the centre of world affairs when Boris Yeltsin, the Russian President, paid a flying visit to Britain.

•The RAF's first female Air Electronics Operator graduated after spending a year at the Air Electronics, Engineer and Loadmaster School at **RAF Finningley.** She was posted to **RAF Kinloss** for an operational conversion to the **Nimrod.**

•Exercise *Brilliant Foil '94* was held in the UK from 3-7 October when RAF aircraft were joined by aircraft from a number of NATO allies. This was a major multi-national air defence exercise to reflect the new NATO command boundaries, which came into effect on 1 July.

•On 11 October six **Tornado GR1s** deployed from **RAF Brüggen** to the Gulf Region, in response to the build-up of Iraqi forces close to the border with Kuwait. This brought the size of the RAF's Tornado force at Dhahran to full squadron strength.

•The Air Defence Battle Command and Control Museum opened at **RAF Neatishead.**

• It was announced that the 16 most seriously damaged Tornado F3 airframes would be rebuilt using the centre sections of the RAF's **Tornado F2s**, most of which have been stored at **St Athan.** The first fuselage (of F2 ZD901) was moved to BAe Warton on 24 October to be used for F3 ZE154.

NEW FACES FOR THE RED ARROWS

RAF Scampton

The RAF Aerobatic Team announced the names of the three new pilots (Flt Lts Richie Matthews, Sean Perrett and Tim Couston) and new Team Manager joining the ***Red Arrows*** for the 1995 season. When the new recruits get their red flying overalls in the Spring, one of them will become the 100th pilot to fly as a member of the team. 1995 will be a particularly busy year with many special events to mark VE and VJ Day in Britain and overseas. One of the first public events after the team returns from its final preparations in Cyprus will be a flypast over Buckingham Palace on the 50th anniversary of VE Day (8 May). Other likely venues include the major events at North Weald (13-14 May), Mildenhall (27-28 May), Biggin Hill (10-11 June), Woodford & RAF St Athan (24 June), RAF Waddington (1-2 June), RNAS Yeovilton (13 July), IAT Fairford (22-23 July), RAF St Mawgan (2 August), Sunderland (5-6 August), IWM Duxford (10 Sep) and RAF Leuchars (16 Sep). Starting 1995 with 2906 public displays behind them, it seems likely that the *Red Arrows* will chalk up their 3000th performance before the end of the season. It is likely that the team will end the year moving from **RAF Scampton** to a new base, presently planned to be **RAF Marham**, Norfolk.

New pilot **Flt Lt Richie Matthews** (Red 2) is aged 27, comes from Ashford, Kent, and was educated at The Norton Knatchbull School. He served with No 305 Ashford Squadron of the ATC, where he rose to the rank of Cadet Flight Sergeant, earned a Flying Scholarship and visited Hong Kong through the International Air Cadet Exchange Scheme. Richie joined the RAF in November 1985 and has spent his operational career flying Jaguars. His first tour was with No 41(F) Squadron at RAF Coltishall in Norfolk and immediately before joining the *Red Arrows* he was a Qualified Weapons Instructor with No 16(R) Sqn, the Jaguar Operational Conversion Unit at RAF Lossiemouth.

Flt Lt Sean Perrett is 31 and hails from Iver, Bucks. He was educated at Langley Grammar School, Berks. His grandfather was a pilot with the Royal Naval Air Service during WW 1 and his father was a National Service pilot with the Army. Sean joined the RAF in January 1985, flying Harriers with No 1 (F) Squadron at RAF Wittering for his first operational tour. He then qualified as a flying instructor and taught students pilots at No 4FTS, Valley, Anglesey. Latterly he served with the Central Flying School's Hawk Squadron at Valley where he was responsible for the flying standards of other Hawk instructors. In his first season he will fly as Red 3.

Red 4, **Flt Lt Tim Couston** (30) comes from Basingstoke and was educated at Cranbourne Bilateral School. He was a member of No 443 Basingstoke Squadron, ATC and reached the highest rank, Cadet Warrant Officer. Tim joined the RAF at the end of 1983 and has served with No 208 Sqn and No 237 OCU, at RAF Lossiemouth flying Buccaneers. He comes to the *Red Arrows* from a tour on Hawks at RAF Chivenor, where he was a Qualified Weapons Instructor.

The new Team Manager, **Sqn Ldr Mike Williams**, was born in 1955 at Birmingham and educated at Bournville Technical Grammar School. He joined the RAF in 1975, initially flying Victors with No 57 Squadron from RAF Marham. He has spent the last ten years flying Tornado GR1s, serving with No 31 Squadron at Bruggen, No 20 Sqn at Laarbruch during the Gulf War and the TTTE at RAF Cottesmore. Mike joined the *Red Arrows* from the Strike Attack Operational Evaluation Unit at Boscombe Down.

No 360 SQUADRON STANDS DOWN

The youngest Royal Air Force Squadron, No 360 Squadron based at **RAF Wyton** stood down at midnight on 31 October after 28 years of continuous service. A joint RN-RAF Squadron, it was equipped with the veteran **Canberra T17** and **T17As**, which provided air defence operators of all three services with realistic electronic counter measures (ECM) training. Its task was replaced by Falcon aircraft operated by FR Aviation.

Andrew March

NOVEMBER

•**No 84 Squadron** at **RAF Akrotiri** converted from **Wessex HC5s** to grey-painted **Wessex HC2s** for its dual SAR/Support Helicopter roles in Cyprus.

•On 11 November a ceremony was held at **RAF Kinloss** to mark the 25th anniversary of the **Nimrod's** entry into operational service. All three based squadrons (Nos 120, 201 and 206) were involved and four aircraft gave a formation display.

•Proposals to move the **Red Arrows** from **RAF Scampton** to **RAF Marham** were outlined in a consultation document published by the Ministry of Defence on 17 November. Under the plan the **Central Flying School** (CFS) flying elements (Tucano and Bulldog) would also move from **Scampton,** the Tucanos relocating to **Linton-on-Ouse or Topcliffe** and the Bulldogs to **Cranwell.** Lodger units at **Scampton** will also relocate.

•Also announced in November was that navigator training at **Finningley (Dominie, Tucano, Hawk** and **Bulldog)** would move in 1995 to **Cranwell (Bulldog and Dominie)**, **Linton-on-Ouse (Tucano)** and **Valley (Hawk).** Multi-engine pilot training (No 45(R) Sqn), using **Jetstreams** would also relocate to **Cranwell.**

• The first British prototype of the **Tornado** (PO2 XX946) arrived at the RAF Museum, Hendon for permanent display.

On 25 November the Battle of Britain Memorial Flight's **Spitfire XIX** PS853 was put up for auction by Sotheby's. This controversial sale was to raise funds to help defray the cost of rebuilding the BBMF's Hurricane LF363. Although the South African purchaser did not complete the sale, it was subsequently bought by Euan English at North Weald.

PRM

DECEMBER

•The purchase of new TIALD laser designator pods, to be shared between ten upgraded **Jaguar GR1Bs** and two **Jaguar T2Bs** at **RAF Coltishall** was announced. The aircraft that will be delivered during 1995 will have gained a wide-angle head-up display, a global positioning system, head-down display for TIALD imagery and HOTAS control columns.

The MoD announced an order for 25 Lockheed **C-130J Hercules** for delivery to the RAF (two in 1996, eight in 1997 and 15 in 1998). The old C-130Ks will be 'traded in' on a one-for-one basis. The remainder of the RAF requirement could be met by a subsequent order for the Future Large Aircraft (FLA).

• **Harrier GR7s** (from Nos 1, 3 and 4 Squadrons) based at Incirlik, Turkey reached 5,000 flying hours on Operation *Warden*, since they took over from Jaguars in April 1993.

RAF's FIRST WOMAN COMBAT PILOT

PRM

PRM

The RAF's first woman Tornado pilot, **Flt Lt Jo Salter**, achieved 'combat ready' status with No 617 Squadron at **RAF Lossiemouth** in December.

Born in Bournemouth, Jo Salter went to school in South London. She secured an RAF University Cadetship and attained an Honours Degree in Electronics Systems Engineering at the Royal Military College of Science at Shrivenham and was commissioned in the Engineer Branch of the RAF. Following the announcement on 1 August 1989 that British women could qualify to fly non-combat aircraft, she applied to train as a pilot and successfully completed the aptitude tests at Biggin Hill the following December. In what was to become a rather long drawn-out training course, as all student aircrew have suffered over the past five years, she started Elementary Flying Training on the Chipmunk at RAF Swinderby (EFTS) in April 1990.

With holding postings between courses, Jo progressed through Basic and Advanced Flying Training and was awarded her wings at No 4 FTS Valley in April 1992. Having achieved good assessments in her flying training and the MoD widening the opportunities on 1 December 1991 for female aircrew to be selected for fast jet combat roles, she was posted to the Tornado GR1. The programme took Jo through the TTTE at Cottesmore and on to No 15(R) Squadron (TWCU) at Lossiemouth. Successfully completing the weapons and operational training she was posted across the airfield to No 617 Squadron, to fly the Tornado GR1B. The squadron had itself only just moved north (in May 1994) to take on the role of maritime attack in addition to its overland strike/attack capability. She achieved her 'combat ready' status with the famous *Dam Busters* squadron in December 1994. Jo has had Flt Lt Paul John Wallace, or 'PJ' as he is better known, crewed with her as navigator since they both joined the squadron.

At the end of 1994 the RAF had 69 female aircrew. Of these there are eight pilots (including Jo Salter) and 12 navigators that have completed their training. The remaining 28 pilots and 21 navigators are all at various stages of their yet unfinished training courses. Of the other seven pilots, two are instructors, two are flying multi-engine turbo-props and three are flying helicopters. Like the pilots there is just one fast-jet navigator, who is on the Tornado F3 at Coningsby; most of the other navigators are on multi-engine aircraft. Female pilots and navigators still only represent a small proportion of the 900 pilots and 300 navigators that have gone through the training machine since 1989.

PRM

The first woman to qualify as an RAF pilot was Flt Lt Julie Gibson (right) in June 1991. After completing a tour as an Andover co-pilot with No 32 Squadron at Northolt, Julie is currently with No 70 Squadron at Lyneham. Since the disbandment of the Women's Royal Air Force on 1 April 1994, opportunities for women in the RAF are the same as for men, with the exception of Regular service in the RAF Regiment.

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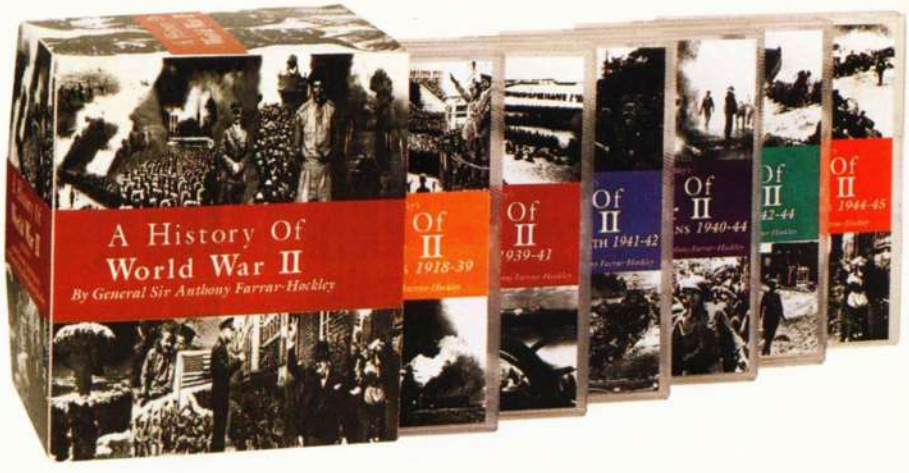

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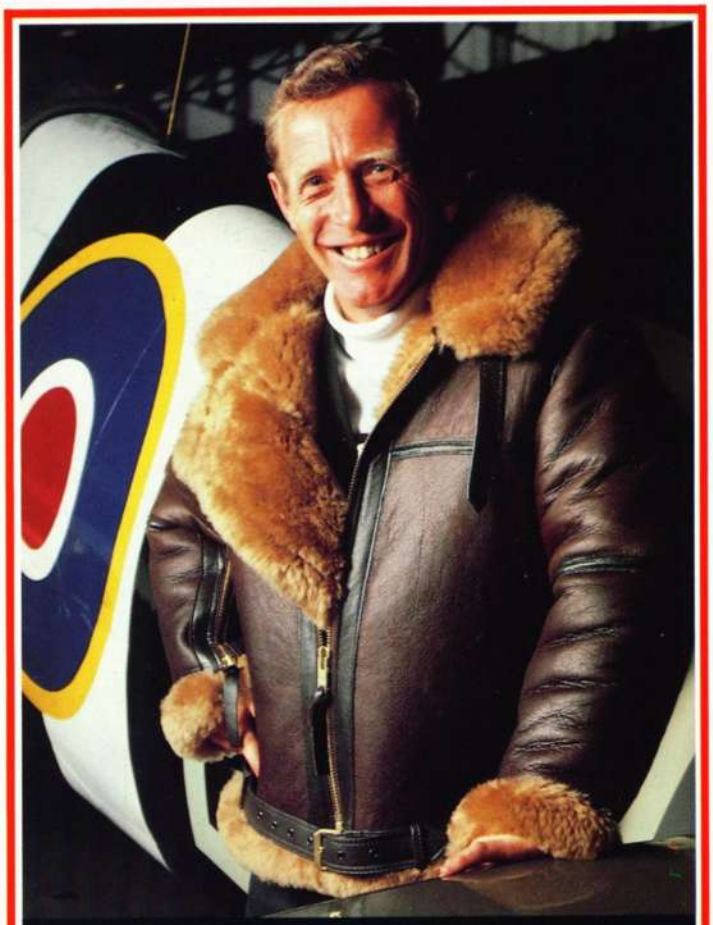

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FLYING SQUADRONS AND UNITS

Squadron	Type & nominal strength	Base
1 Sqn	Harrier GR7 (13)/T4 (1)	Wittering/Incirlik
2 Sqn	Tornado GR1A (13)/GR1 (2)	Marham
3 Sqn	Harrier GR7 (13)	Laarbruch/Incirlik
4 Sqn	Harrier GR7 (13)	Laarbruch/Incirlik
5 Sqn	Tornado F3 (14)	Coningsby
6 Sqn	Jaguar GR1A/B (13)/T2A/B (2)	Coltishall/Gioia del Colle
7 Sqn	Chinook HC2 (18)/Gazelle HT3 (2)	Odiham/Aldergrove
8 Sqn	Sentry AEW1 (7)	Waddington/Aviano/Trapani
9 Sqn	Tornado GR1 (13)	Brüggen
10 Sqn	VC10 C1K (9)/C1 (4) [to be 10 C1K]	Brize Norton/Muharraq
11 Sqn	Tornado F3 (17)	Leeming/Gioia del Colle
12 Sqn	Tornado GR1/1B(13) [to be GR1B]	Lossiemouth
13 Sqn	Tornado GR1A (13)	Marham
14 Sqn	Tornado GR1 (13)	Brüggen/Dhahran
15(R) Sqn (TWCU)	Tornado GR1 (22)	Lossiemouth
16(R) Sqn (JOCU)	Jaguar GR1A (6)/T2A (6)	Lossiemouth
17 Sqn	Tornado GR1 (13)	Brüggen/Dhahran
18 Sqn	Puma HC1 (5)/Chinook HC2 (6) Gazelle HT3 (1)	Laarbruch
19(R) Sqn (CFS)	Hawk T1 (3)/T1A (7)	Valley
20(R) Sqn (HOCU)	Harrier GR7/T4/T10 (15)	Wittering
22 Sqn HQ	Wessex HC2/Sea King HAR3	St Mawgan
A Flt	Sea King HAR3 (2)	Chivenor
B Flt	Sea King HAR3 (2)	Wattisham
C Flt	Wessex HC2 (2) [Sea King HAR3A 1996]	Valley
24 Sqn	Hercules C1/C3 (14)	Lyneham
25 Sqn	Tornado F3 (17)	Leeming/Gioia del Colle
27(R) Sqn (OCU)	Puma HC1 (5)/Chinook HC2 (6)	Odiham
28 Sqn	Wessex HC2 (6)	Sek Kong
29 Sqn	Tornado F3 (14)	Coningsby
30 Sqn	Hercules C1/C3 (13)	Lyneham
31 Sqn	Tornado GR1 (13)	Brüggen/Dhahran
32 (The Royal) Sqn	HS125 CC2 (2)/BAe125 CC3 (6) Gazelle HCC4 (4)BAe 146 CC2 (3) Wessex HCC4 (2)	Northolt
33 Sqn	Puma HC1 (12)	Odiham
39 (1PRU) Sqn	Canberra PR9 (5)/PR7 (2)/T4 (3)	Marham
41 Sqn	Jaguar GR1A (13)/T2A (1)	Coltishall/Gioia del Colle
42(R) Sqn (NOCU)	Nimrod MR2 (*)	Kinloss
43 Sqn	Tornado F3 (15)	Leuchars
45(R) Sqn (6FTS)	Jetstream T1 (10)	Finningley [Cranwell late-1995]
47 Sqn	Hercules C1/C3 (13)	Lyneham
51 Sqn	Nimrod R1 (3)	Wyton [Waddington mid-1995]
54 Sqn	Jaguar GR1A/B (13)/T2A/B (2)	Coltishall
55(R) Sqn (OCU)	VC10 C1/C1K/K2/K3/K4 (*)	Brize Norton
56(R) Sqn (F3 OCU)	Tornado F3 (22)	Coningsby
57(R) Sqn (OCU)	Hercules C1/C1K/C3 (5)	Lyneham
60 Sqn	Wessex HC2 (9)	Benson
70 Sqn	Hercules C1/C3 (13)	Lyneham
72 Sqn	Wessex HC2 (15)	Aldergrove
74(R) Sqn (4 FTS)	Hawk T1/T1A (30)	Valley
78 Sqn	Chinook HC2 (2)/Sea King HAR3 (2)	Mount Pleasant
84 Sqn	Wessex HC2 (5)	Akrotiri
100 Sqn	Hawk T1/T1A (16)	Finningley [Leeming late-1995]
101 Sqn	VC10 K2/K3 (9)/K4 (5)	Brize Norton/Incirlik
111 Sqn	Tornado F3 (15)	Leuchars
120 Sqn	Nimrod MR2 (9 from Kinloss MR Wg)	Kinloss
201 Sqn	Nimrod MR2 (9 from Kinloss MR Wg)	Kinloss
202 Sqn HQ	Sea King HAR3	Boulmer
A Flt	Sea King HAR3 (2)	Boulmer
D Flt	Sea King HAR3 (2)	Lossiemouth
E Flt	Sea King HAR3 (2)	Leconfield
206 Sqn	Nimrod MR2 (8 from Kinloss MR Wg)	Kinloss
208(R) Sqn (4 FTS)	Hawk T1/T1A (30)	Valley
216 Sqn	Tristar K1(2)/KC1(4)/C2(2)/C2A(1)	Brize Norton/Palermo
230 Sqn	Puma HC1 (15)	Aldergrove
617 Sqn	Tornado GR1B (13)	Lossiemouth

(*) Aircraft from based squadrons

OVERSEAS BASED FLIGHTS & OPERATIONAL DETACHMENTS (included in above nominal strengths)

1312 Flt	Hercules C1K (2)	Mount Pleasant
1435 Flt	Tornado F3 (4)	Mount Pleasant
Operation *Grapple*	Jaguar GR1A (12)/Tornado F3 (8)	Gioia del Colle
Operation *Warden*	Harrier GR7 (8)/VC10 K2/3/4 (2)	Incirlik
Operation *Jural*	Tornado GR1 (8)	Dhahran
	VC10 C1K (1)	Muharraq

OTHER FLYING UNITS

1 FTS	Tucano T1 (39)	Linton-on-Ouse
2 FTS*	Gazelle HT3 (19)/Wessex HC2 (10)	Shawbury
3 FTS	Tucano T1 (56)	Cranwell [Linton-on-Ouse late-'95]
4 FTS/CFS#	Hawk T1/1A (72)	Valley
6 FTS	Bulldog T1 (5)/Dominie T1 (11)	Finningley [Cranwell mid-1995]
	Hawk T1 (9)	Finningley [Valley mid-1995]
	Tucano T1 (9)	Finningley [Topcliffe mid-1995]

Unit	Type & nominal strength	Base
Joint Elementary Flying Training School (JEFTS)	T67M-2 Firefly (18 civilian)	Topcliffe [Barkston Heath mid-'95]
Central Flying School (CFS)	Bulldog T1 (12)/Chipmunk T10 (1)	Scampton [Cranwell late-1995]
	Tucano T1 (21)	Scampton [Topcliffe late-1995]
CFS (Helicopter)	Gazelle HT2/3 (From 2 FTS)	Shawbury
Search and Rescue Training Unit	Wessex HC2 (5)	Valley
Sea King Training Unit	Sea King HAR3 (2)	St Mawgan
Air Warfare Centre	HarrierT4/GR7/Jaguar GR1B/T2B	Boscombe Down
(Strike/Attack OEU)	Tornado GR1/1A/1B	
(F3 OEU)	Tornado F3 (5)	Coningsby
Tri-National Tornado Training Establishment	Tornado GR1 (16)	Cottesmore
Northolt Stn Flt	Islander CC2/2A (2)	Northolt
St Athan Stn Flt	Hawk T1 (1)	St Athan
Red Arrows	Hawk T1/T1A (11)	Scampton [Marham end-'95 tbc]
Battle of Britain Memorial Flight	Spitfire/Hurricane/Lancaster Chipmunk/Dakota	Coningsby

* *From 1 April 1997 will become the Defence Helicopter Flying School at RAF Shawbury.*

\# *See Nos 19(R), 74(R) and 208(R) Squadrons.*

AIR EXPERIENCE FLIGHTS

1 AEF	Chipmunk T10 (4)	Manston
2 AEF	Chipmunk T10 (4)	Bournemouth/Hurn
3 AEF	Chipmunk T10 (6)	Colerne
4 AEF	Chipmunk T10 (4)	Exeter
5 AEF	Chipmunk T10 (8)	Cambridge/Teversham
6 AEF	Chipmunk T10 (8)	Benson
7 AEF	Chipmunk T10 (4)	Newton
8 AEF	Chipmunk T10 (4)	Shawbury
9 AEF	Chipmunk T10 (4)	Finningley
10 AEF	Chipmunk T10 (4)	Woodvale
11 AEF	Chipmunk T10 (4)	Leeming
12 AEF	Chipmunk T10 (4)	Edinburgh/Turnhouse
13 AEF	Bulldog T1	Belfast/Aldergrove

UNIVERSITY AIR SQUADRONS

Aberdeen, Dundee & St Andrews UAS	Bulldog T1 (5)	Leuchars
Birmingham UAS	Bulldog T1 (4)	Cosford
Bristol UAS	Bulldog T1 (5)	Colerne
Cambridge UAS	Bulldog T1 (4)	Cambridge
East Lowlands UAS	Bulldog T1 (4)	Edinburgh/Turnhouse
East Midlands UAS	Bulldog T1 (6)	Newton
Glasgow & Strathclyde UAS	Bulldog T1 (4)	Glasgow
Liverpool UAS	Bulldog T1 (4)	Woodvale
London UAS	Bulldog T1 (9)	Benson
Manchester UAS	Bulldog T1 (5)	Woodvale
Northumbrian UAS	Bulldog T1 (6)	Leeming
Oxford UAS	Bulldog T1 (5)	Benson
Queens UAS	Bulldog T1 (5)	Aldergrove
Southampton UAS	Bulldog T1 (7)	Boscombe Down
Wales UAS	Bulldog T1 (7)	St Athan
Yorkshire UAS	Bulldog T1 (8)	Finningley
RAF College Air Squadron	Bulldog T1 (6)	Cranwell

VOLUNTEER GLIDING SCHOOLS

611 VGS	Viking TX1 (5)	Swanton Morley
612 VGS	Vigilant T1 (2)	Halton
613 VGS	Vigilant T1 (3)	Halton
614 VGS	Viking TX1 (5)	Wethersfield
615 VGS	Viking TX1 (5)	Kenley
616 VGS	Vigilant T1 (5)	Henlow
617 VGS	Viking TX1 (4)	Manston
618 VGS	Viking TX1 (7)	Challock
621 VGS	Viking TX1 (4)	Hullavington
622 VGS	Viking TX1 (6)	Upavon
624 VGS	Vigilant T1 (3)	Chivenor
625 VGS	Viking TX1 (4)	Hullavington
626 VGS	Viking TX1 (3)	Predannack
631 VGS	Viking TX1 (7)	Sealand
632 VGS	Vigilant T1 (4)	Ternhill
633 VGS	Vigilant T1 (5)	Cosford
634 VGS	Viking TX1 (3)	St Athan
635 VGS	Vigilant T1 (5)	Samlesbury
636 VGS	Viking TX1 (4)	Swansea
637 VGS	Vigilant T1 (4)	Little Rissington
642 VGS	Vigilant T1 (5)	Linton-on-Ouse
645 VGS	Viking TX1 (5)	Catterick
661 VGS	Viking TX1 (4)	Kirknewton
662 VGS	Viking TX1 (4)	Arbroath
663 VGS	Vigilant T1 (3)	Kinloss
Air Cadet CGS	Kestrel TX1 (2)/Valiant TX1 (4)	Syerston
	Vigilant T1 (12)/Viking TX1 (20)	

STATIONS & SUPPORT BASES

Akrotiri	No 84 Sqn, No 34 Sqn RAF Regiment. Support for UN Peacekeeping in Cyprus, Armament Practice Camp
Aldergrove	Nos 72 & 230 Sqns, Queens University Air Sqn, No 13 Air Experience Flight, No 3 Sqn RAF Regiment, P&SS (NI)
Aldershot	RAF School of Catering
Ascension Island	Staging post
Ash	AWC Air Defence Ground Environment OEU, C&RPO, RAF Fighter Control School
Bampton Castle	No 81 Signals Unit, No 2 Signals Unit
Barkston Heath	Relief Landing Ground for Cranwell
Benbecula	No 71 Signals Unit
Benson	HQ 1 Group, No 60 Sqn, London University Air Sqn, Oxford University Air Sqn, No 6 Air Experience Flight, MCSU
Bentley Priory	HQ 11 Group
Bicester	RAFGSA Centre
Bishops Court	Radar Head
Boddington	No 9 Signals Unit, HQ TARE units
Boulmer	No 75 Signals Unit, No 144 Signals Unit, No 500 Signals Unit, HQ No 202 Sqn, No 202 Sqn 'A' Flight, School of Fighter Control
Bracknell	RAF Staff College
Brampton	HQ Logistics Command, JARIC, Air Commander Home Defences
Brawdy	Reduced to enclave March 1993, US Naval Post July 1994, Closes Sept 1995
Brize Norton	No 10 Sqn, No 101 Sqn, VC10 Operational Conversion Unit (No 55 (R) Sqn), No 216 Sqn, Brize Radar, JATE, TCW, No 1 Parachite Training School, No 4624 (County of Oxford) Sqn RAuxAF, No 2624 (County of Oxford Sqn) RAuxAF Regiment, Military Emergency Diversion Airfield
Brüggen	Nos 9, 14, 17, 31 Sqns, No 37 Sqn RAF Regiment
Buchan	No 170 Signals Unit, No 487 Signals Unit, Control Reporting Centre
Cardington	No 217 Maintenance Unit, Compressed Gas Supply Depot, Oxygen Training School
Carlisle	No 14 Maintenance Unit
Chattenden	Defence Explosive Ordnance Disposal School
Chivenor	Care & Maintenance October 1994, 'A' Flight No 22 Sqn, No 624 Volunteer Gliding School
Church Fenton	Relief Landing Ground for Linton-on-Ouse
Cowden	East Coast Bombing Range
Coltishall	Nos 6, 41 and 54 Sqns
Coningsby	Nos 5 and 29 Sqns, Tornado F3 Operational Conversion Unit (No 56 (R) Sqn), Battle of Britain Memorial Flight, Air Warfare Centre/F3 OEU.
Cosford	Birmingham University Air Sqn, No 633 Volunteer Gliding School, No 1 School of Technical Training, Aerospace Museum
Cottesmore	TTTE, TMS
Cranwell	RAF College, No 3 Flying Training School (*), RAF College Air Sqn, Headquarters University Air Sqn, DoR&S, RAFGSA Cranwell Gliding Club
Digby	No 399 Signals Unit, No 591 Signals Unit, Aerial Erector School
Dishforth	Relief Landing Ground for Linton-on-Ouse, RAFGSA Cleveland Gliding Club
Donna Nook	Wash (North Side) Bombing Range
Fairbourne	RITC
Finningley	No 6 Flying Training School (*), No 100 Sqn (*), JFACTSU (*), Yorkshire UAS (*), No 9 Air Experience Flight (*) Closing 1996
Fylingdales	Phased Radar
Halton	Nos 612 and 613 Volunteer Gliding Schools, School of Recruit Training, ACS, PMRAFH, IDHT, IHMT, IPTM
Headley Court	Defence Services Medical Rehabilitation Unit
Henlow	RAF Signals Engineering Establishment, OCS, Radar Introduction Unit, No 616 Volunteer Gliding School, Civilian Technical Training School
High Wycombe	HQ Strike Command, HQ AFNORTHWEST, HQ No 38 Group, HQ Air Warfare Centre, Primary War HQ, No 7006 Flt RAFVR
Holbeach	Wash Bombing Range
Honington	RAF Regiment Depot, Nos 2, 16(R) and 20 Sqns RAF Regiment, No 2623 (East Anglian) Trg Sqn RAuxAF Regiment, AWC Surface-to-Air Weapons OEU
Innsworth	HQ Personnel and Training Centre, RAF Computer Centre, No 7644 Flt RAFVR
Kinloss	Nos 120, 201, 206 Sqns, Nimrod Operational Conversion Unit (No 42 (R) Sqn), No 633 Volunteer Gliding School, RAF Mountain Rescue Team, RAFGSA Fulmar Gliding Club
Laarbruch	Nos 3, 4 and 18 Sqns, Nos 1 and 26 Sqns RAF Regiment
Leeming	Nos 11 and 25 Squadrons, Northumbria University Air Squadron, No 11 Air Experience Flight, RAF Mountain Rescue Team, No 15 Sqn RAF Regiment
Leuchars	Nos 43 and 111 Sqns, Aberdeen, Dundee & St Andrews University Air Sqn, No 27 Sqn RAF Regiment, RAF Mountain Rescue Team, Military Emergency Diversion Airfield
Lindholme	No 840 Signals Unit
Linton-on-Ouse	No 1 Flying Training School, No 642 Volunteer Gliding School
Llanwrst	JSATI
Locking	No 1 Radio School, Basic Computer and Management Training Sqn, Main School of Radio and Radar, Western Band RAF
Lossiemouth	Jaguar Operational Conversion Unit (No 16 (R) Sqn), TWCU (No 15 (R) Sqn), Nos 12 and 617 Sqns, 'D' Flight No 202 Sqn, No 48 Sqn RAF Regiment, No 2622 (Highland) Sqn RAuxAF Regiment
Lyneham	Nos 24, 30, 47 and 70 Sqns, Hercules Operational Conversion Unit (No 57 (R) Sqn), UK MAMS, No 1 AES
Macrihanish	Enhanced Care & Maintenance
Manston	RAF Fire Service Central Training Establishment, No 1 Air Experience Flight, No 617 Volunteer Gliding School, 'C' Flight No 202 Sqn
Marham	Nos 2 and 13 Sqns, No 39 (1 PRU) Sqn, No 2620 (County of Norfolk) Sqn RAuxAF Regiment
Mona	Relief Landing Ground for Valley
Mount Pleasant	HQ BFI, No 78 Sqn, No 1312 Flight, No 1435 Flight, RAF Regiment Rapier Detachment, No 7 Signals Unit, No 303 Signals Unit, No 751 Signals Unit
Mountwise	Rescue Co-ordination Centre Plymouth Rescue
Neatishead	Nos 86 and 432 Signals Units, Control Reporting Centre
Newton	Reduced to enclave March 1995, retains HQ P&SS Northern Region, HQ Air Cadets, East Midlands University Air Sqn, No 7 Air Experience Flight, RAF Provost and Security Service (Police and Police Dog School)
Nocton Hall	Forward Outpatients Department
Nordhorn	Air Weapons Range
North Luffenham	Ground Radio Servicing Centre, Radio Technical Publications Sqn, Radio Introduction Unit, RIV Detachment, Aviation Medicine Training Centre, Language School
Northolt	No 32 (The Royal) Sqn, No 1 Maritime HQ (County of Hertford) RAuxAF, 1 AIDU
Northwood	HQ No 18 Group, Joint Maritime HQ, No 1 County of Hertfordshire Maritime Unit, RAuxAF, AWC Long-Range Maritime Patrol Cell
Oakhanger	No 1001 Signals Unit, No 1 Radio School Detachment
Odiham	Nos 7 and 33 Sqns, Puma/Chinook Operational Conversion Unit (No 27 (R) Sqn) AWC Tactical Trials Flight
Pembrey Sands	Bombing Range
Pitreavie Castle	Air Officer, Scotland & NI Maritime HQ, Rescue Co-ordination Centre, parented by RAF Turnhouse
Portreath	No 405 Signals Unit (Navigational Air Defence Radar Station), became satellite of St Mawgan in October 1994
Prestwick	Scottish Air Traffic Control Centre
Quedgeley	No 7 Maintenance Unit
Rheindahlen	Joint Support Unit (JSU), HQ No 2 Group, HQ P&SS (Germany), Band of RAF in Germany
Rosehearty	Weapons Range
Rudloe Manor	Nos 1 and 6 Signals Units, MoD Defence Communications Network, HQ P&SS (UK), RAF PSS Southern Region
Saxa Vord	No 91 Signals Unit
Scampton	HQ CFS, RAF *Red Arrows*, No 27 Sqn RAF Regiment, TMTS, JACIG, RAFGSA Humber Gliding Club (Closing 1996, all units *)
Sealand	Avionic Maintenance Unit, No 30 Maintenance Unit, Civilian Technical Training School
Sek Kong	No 28 Sqn
St Athan	No 4 School of Technical Training, Wales University Air Sqn, No 634 Volunteer Gliding School, RAF Mountain Rescue Team, Civilian Technical Training School
St Mawgan	HQ No 22 (SAR) Sqn, Sea King Training Unit, No 2625 (County of Cornwall) Sqn RAuxAF Regiment, No 3 Maritime HQ (County of Devon) RAuxAF, RAFSCSR
Shawbury	No 2 (H) Flying Training School, No 8 Air Experience Flight
Spadeadam	NATO ECM Range
Stafford	No 16 Maintenance Unit (includes TCW), RAF Mountain Rescue Team, No 2 MT Sqn
Stanbridge	Joint Services Trooping Centre, RAF Logistics Centre, Supply Computer Centre. Reducing to enclave October 1995
Staxton Wold	No 129 Signals Unit, No 146 Signals Unit, UKADGE RP
Swanton Morley	Central Servicing Development Establishment, Logistics Support Services, No 611 Volunteer Gliding School, Maintenance Analysis & Computing Division. Closing October 1995
Syerston	ACCGS, No 644 Volunteer Gliding School, RAF Police Dog School
Tain	Bombing Range
Thatcham	UK National Distribution Agency
Topcliffe	Joint Elementary Flying Training School (*)
Turnhouse	HQ P&SS (Scotland), East Lowlands University Air Sqn, No 12 Air Experience Flight, No 2 Maritime HQ (City of Edinburgh) RAuxAF, JMOTS
Uxbridge	HQ MATO, HQ Music Services, Queen's Colour Sqn (No 63 Sqn RAF Regiment)
Valley	No 4 Flying Training School (comprising Nos 74 & 208 (R) Sqns), CFS/No 19(R) Sqn, 'C' Flight No 22 Sqn, Search and Rescue Training Unit, RAF Mountain Rescue Team
Waddington	No 8 Sqn, No 2503 (County of Lincoln) Sqn RAuxAF Regiment
Wainfleet	East Coast Bombing Range
Wattisham	RAF Air Traffic Control
Wegberg	RAF Hospital
West Drayton	Enclave. LATCC MIL and LATCC CIV
Wittering	No 1 Sqn, Harrier Operational Conversion Unit (No 20 (R) Sqn), RAF Armament Supply Unit
Woodvale	Liverpool University Air Sqn, Manchester & Salford University Air Sqn, No 10 Air Experience Flight
Wroughton	Princess Mary's RAF Hospital
Wyton	No 51 Sqn (moving to Waddington mid-1995). No 7010 Flt RAFVR, Elements of HQ Logistics Command

Note: (*) indicates a change to take place in 1995

OTHER AIRFIELDS WITH RAF LODGER UNITS

A&AEE Boscombe Down	ETPS, AWC Strike/Attack OEU, Southampton UAS	**Exeter**	No 4 AEF
Arbroath	No 662 VGS	**Hullavington**	Nos 621 & 625 VGSs
Bournemouth-Hurn	No 2 AEF	**Kirknewton**	No 661 VGS
Cambridge-Teversham	Cambridge UAS, No 5 AEF	**Little Rissington**	No 637 VGS
Catterick	No 645 VGS	**Predannack**	No 626 VGS
Challock	No 618 VGS	**Samlesbury**	No 635 VGS
		Swansea	No 636 VGS
		Wethersfield	No 614 VGS

Tornado F3s of No 11 Sqn on detachment to Gioia del Colle (Italy) for Operation Deny Flight.

RAF Leeming

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The 'Bucc' seen during the last six months of operations, flying 'Faster, Lower, Longer' right to the end of its days. This excellent film contains beautiful air to air shots over Scotland, a complete 'walkround' and some incredibly low flying sequences. The footage from Gibraltar is particularly good including a ship attack, a display seen from inside the cockpit, refuelling from Hercules and another Bucc, and an arrestor gear landing. Good use of informative text across the bottom of the picture and if there is any critism it is that RAF pilots are not professional actors when being interviewed!
48min. £16.99 inc. UK p&p.

Display Aircraft Series Volume 1 - Su-27 Flanker

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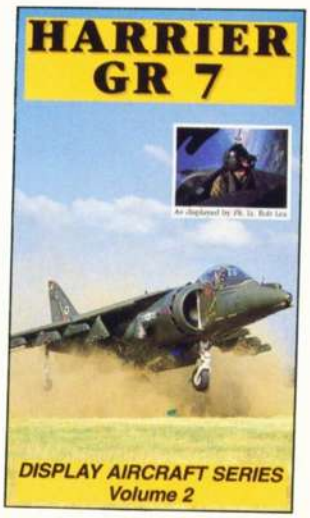
What is it like in the cockpit of this Russian Superfighter? Few aircraft can match Anatoly Kvotchur's awesome display in the Su-27, especially the legendary Cobra manoeuvre. See them *from inside the cockpit* and from a variety of angles as Anatoly displays the aircraft to the full, including an extended practice routine with no less than 6 Cobras. Plus, Western reaction to the arrival of the Su-27 and what really happened when Anatoly's MiG-29 crashed at the Paris Air Show. Expert analysis and comment from John Farley (BAe Harrier Chief Test Pilot) rounds off this excellent film.
53min. £16.99 inc. UK p&p.



Display Aircraft Series Volume 2 - Harrier GR7

Flt Lt Rob Lea is one of the best Harrier display pilots ever and this video shows just why. Filmed at a variety of locations, this film is packed with information and the on board camera gives a unique view of Rob dispaying the Harrier. See him preparing for the displays, practising the routine in the Harrier simulator and explaining just how the Harrier manages to bow to the crowd. The foreword is by Bill Bedford, the first Harrier Test Pilot, who describes the evolution of the aircraft from P1127 through to the incredibly advanced GR7.
55min. £16.99 inc. UK p&p.

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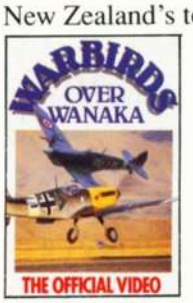

Warbirds over Wanaka 1992 and 1994

Great examples of how airshows are done "Down Under". Warbirds galore with some 'extras' thrown in for added entertainment. Filmed using multiple cameras to capture the best angles, the 1992 show includes a Battle of britain 'replay' with Me 109 vs Spitfire and Sea Fury, Corsair, Kitty Hawk and others. "....Includes some of the most spectacular air-to-air photography this reviewer has seen for some time.' Flypast. 60mins. £16.99 inc. UK p&p.

Warbirds over Wanaka 1994 includes more incredible aerial footage with 2 Spitfires and a P51 flying through the snow covered mountain ranges which surround the airfield. The airshow is varied and well presented and the 'extras' are worth seeing - for example a race between a Pitts, a helicopter and a motor bike and a glider being launched by a helicopter!! 56 min. £16.99 inc. UK p&p.

WARBIRD BEST SELLERS

Messerschmitt Bf 109 Black 6

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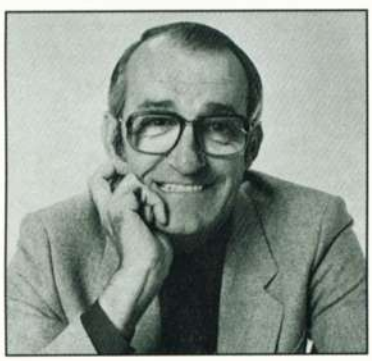

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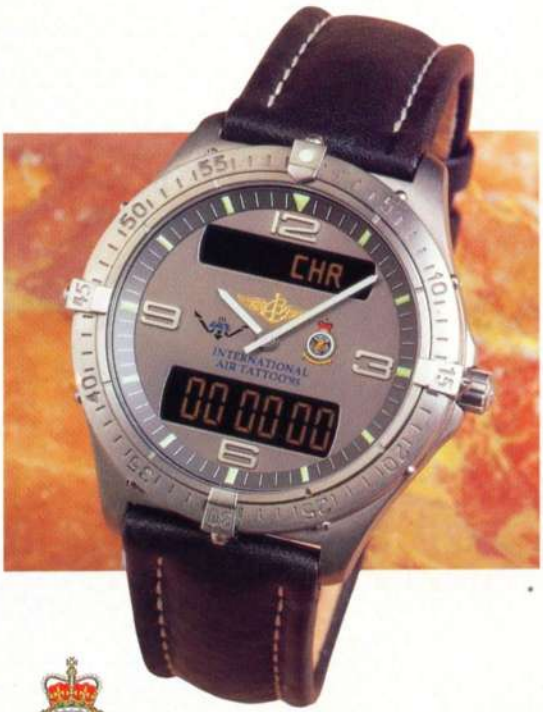

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