

Royal Air Force



YEARBOOK 1990

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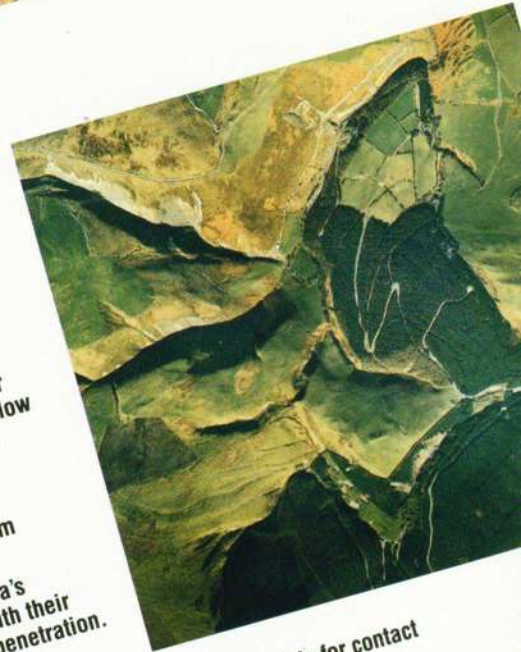
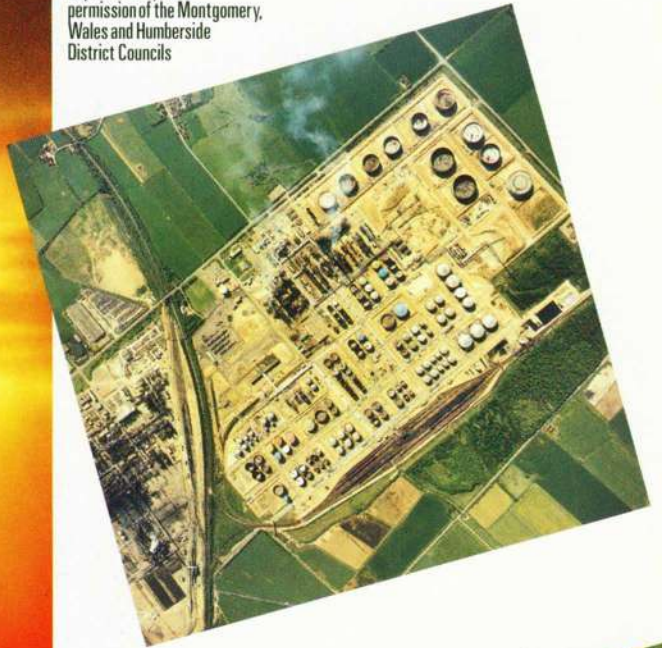
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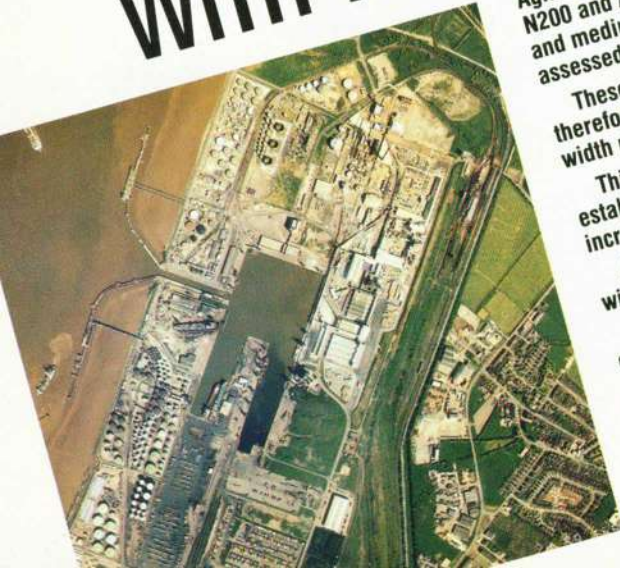
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Royal Air Force

YEARBOOK 1990



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INTRODUCTION

Air Chief Marshal Sir Peter Harding,

GCB, ADC, FRAeS, CBIM, RAF

Chief of the Air Staff

In 1990 we celebrate the 50th Anniversary of the Battle of Britain, an occasion of great significance not just to the Royal Air Force but to our nation as a whole. The Battle was one of the decisive events of the Second World War; upon it depended the survival of Great Britain, with all the consequent implications for the subsequent liberation of Western Europe and final victory. Moreover, it was fought not on some isolated and distant battlefield but in full view of a large section of the civilian population, who themselves were soon deeply involved as the enemy air attacks turned from radar sites and airfields to the cities. It is not surprising, therefore, that the Battle of Britain retains such great significance for the people of this country and has rightly taken its place in the national consciousness alongside such names as Trafalgar and Waterloo.

Now, as in 1940, the air defence of the United Kingdom and its environs remains one of the principal tasks of the Royal Air Force. Today's equipment is of course far more capable than that of 50 years ago, but one key factor has not changed since 1940: the best weapons systems in the world are of little use without the right people to operate and support them. The Royal Air Force of today still relies upon well-trained, highly motivated and courageous men and women to sustain its operational capability; in return, it offers a challenging and rewarding life unmatched by any other profession. I encourage you to attend one of the many celebrations that are being held by the Royal Air Force throughout the country in 1990 to mark the 50th Anniversary of the Battle of Britain; there you will have the chance to see the quality of our people and equipment for yourselves.



However, many of those Royal Air Force personnel who served in the Second World War and their dependants are now of an age where they are in need of help and support. Through the excellent work of the Royal Air Force Benevolent Fund many of those who contributed so much to their country now receive the assistance they so badly need and so richly deserve. But the Fund's resources are coming under increasing pressure, and if it is to continue to help those in need it must raise more money. It has therefore launched a special Battle of Britain Anniversary Appeal. I encourage you to read more about the Fund's activities in this Yearbook and to support the Appeal as generously as you can. 1990 is a year for great celebration, but it is also an excellent opportunity for us all to express our gratitude in a tangible form to those who have served their country with such dedication.

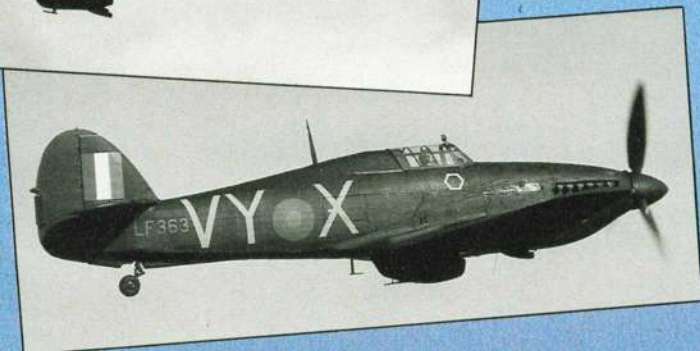


THE ROYAL AIR FORCE Battle of Britain Memorial Flight

Right: Now back in its original PR blue scheme, the PR19 PS853 shows its classic lines to an air show audience. PRM

Left top: The photo-reconnaissance Spitfire PR19 PM631 painted with 1944 invasion stripes on the wings and fuselage. PRM

Left bottom: Black overall paint scheme carried by Hurricane LF363 when it represented a night-fighter of No 85 Squadron. PRM



Robert Rudhall

In this, the 50th Anniversary year of the Battle of Britain, no other aircraft will be in more demand for air show appearances, than those of the Royal Air Force Battle of Britain Memorial Flight. The five Spitfires, two Hurricanes and the Lancaster are due to make over 100 appearances at air displays, rallies, fetes and many other events all over the UK.

The Battle of Britain Memorial Flight, or as it is more commonly known, the BBMF, is a tangible reminder to everybody of the role that the men and women of the RAF played in the winning of World War Two, a war that was not without tremendous losses in all Commands of the RAF. During the Battle of Britain period, RAF Fighter Command lost some 915 aircraft with the resulting loss of over 500 pilots and aircrew. During the RAF's Bomber Offensive, which lasted from the first day of the war to almost within a few hours of the final victory in Europe, some five and a half years later, more than a third of a million sorties were flown with nearly 9,000 bomber aircraft being lost and 50,000 airmen killed, a tremendous sacrifice in anyone's eyes. It is to remember this sacrifice that the aircraft of the BBMF will always be a living memorial to all the husbands, wives, girlfriends,

brothers and sisters that did not survive the last world conflict.

15 September 1945 saw proud and very thankful Londoners turning their eyes upwards to watch a mass formation of RAF fighters taking part in what was to become the annual Battle of Britain Flypast over the City of London, the city that Fighter Command had so gallantly defended five years earlier. Leading the formation was a Hurricane and Spitfire flown by veterans of the Battle, but as the years went on, finding a serviceable Hurricane proved to be a difficult task as the type rapidly disappeared from the RAF's aircraft inventory, until eventually one particular Hurricane was singled out for this task. A Mk IIC Hurricane, LF363, was on strength with the Station Flight at RAF Thorney Island and it was this Hurricane that was prepared each year for the London Flypast. By 1957 the demise of the Spitfire in RAF service had prompted the idea of a special Flight of historic aircraft, primarily to lead the London Flypast each year, but also to act as a memorial to the RAF's greatest battle honour, the Battle of Britain. Since 1951 the civilian operated Temperature and Humidity (THUM) Flight at Hooton Park and Woodvale had been using Spitfire PR19s for daily meteorological

ascents for weather forecasting purposes. By June 1957 the Spitfires had come to the end of their useful lives with the THUM Flight and by 26 June all three aircraft (PM631, PS853 and PS915) had been handed back to the RAF and flown to the RAF Aircraft Disposal Unit at Duxford in Cambridgeshire.

On 11 July 1957 the three Spitfire XIXs took off from Duxford and flew to RAF Biggin Hill, where they were met by the Commander in Chief, RAF Fighter Command, Air Chief Marshal Sir Thomas Pike along with several high-ranking RAF officers. Waiting for the Spitfires was Hurricane LF363 which had arrived some months earlier and it was on this day that Sir Thomas Pike announced the formation of the Battle of Britain Flight.

Even though the Flight had been seen to be approved by the Air Ministry, there were difficulties from certain quarters about the existence of the Flight, so in the early days the aircraft were officially on charge to the Station Flight at Biggin Hill and were known as the 'Historic Aircraft Flight'.

Just two months later the Flight lost a Spitfire, when PS915 was relegated to gate guardian duties at West Malling in Kent. This Spitfire was to guard various gates during the next 17 years before being totally rebuilt for the BBMF by British Aerospace



Above: Lancaster B1 PA474 joined the BBMF in November 1973. PRM



Spitfire Vb AB910 was presented to the RAF by Vickers Armstrong in 1965.

at Warton and Salmesbury, rejoining the flight in March 1987.

Later in 1957 a trio of Spitfire Mk XVI's that had been renovated for that year's Royal Tournament were added to the strength of the Biggin Hill Station flight and were restored to flying condition on the instigation of the then Station Commander. One of these aircraft, TE330, was dispatched to the USAF Museum at Wright-Patterson AFB, Ohio and the remaining pair, SL574 and TE476, would be available for the flight to use.

Early in 1958 the RAF closed down Biggin Hill for flying operations and the aircraft of the flight were transferred to the RAF North Weald Station Flight, moving there in February of that year. Whilst at North Weald the Flight had to part with another of the PRXIX Spitfires when PS853 moved to West Raynham to take up gate guardian duties. To add insult to injury the Air Ministry decided to close North Weald, so in May the aircraft of the flight moved once more, this time to Martlesham Heath.

On 20 September 1959 Spitfire XVI SL574 along with Hurricane IIC LF363 took off to take part in the annual Battle of Britain flypast over the City of London. Sadly only the Hurricane returned. The Spitfire had

suffered an engine failure and, thanks to some skilful piloting by Air Vice Marshal H Maguire, the Spitfire was force-landed safely on a cricket pitch at Bromley. Unfortunately the implications of this accident were two-fold. First, the other Mk XVI Spitfire TE476 was grounded, based on a theory that the Packard-built Merlin, which powered that particular mark of Spitfire, was unreliable (a theory that was completely unfounded). Secondly, the annual participation of the Spitfire and Hurricane in the London flypast was discontinued.

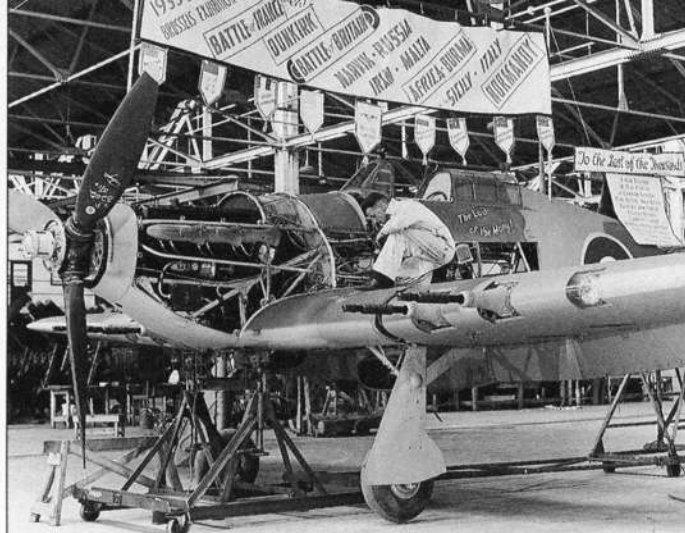
In November 1961 the Flight was on the move once more, this time to Horsham St

Faith, better known today as Norwich Airport. At this time the Flight was at its lowest ebb, with only Spitfire PRXIX PM631 and Hurricane IIC LF363 on strength. However, during this period the importance of maintaining these aircraft as a flying memorial was realised by the powers that be and steps were taken to put the Flight on a more stable and permanent footing than before. Therefore the name Battle of Britain Flight was officially adopted.

In April 1962, with the closure of Horsham St Faith, the Spitfire and Hurricane moved to RAF Coltishall which at that time was one of RAF Fighter Command's top



Hurricane IIC LF363 in the colours of an aircraft flown by Douglas Bader with No 242 Sqn in 1940.



Above: PZ865 was the 'Last of the Many' Hurricanes to leave the Hawker production line. Flown as G-AMAU it was operated by the manufacturer until donated to the BBMF in March 1972 and now flies in No 303 (Polish) Squadron colours. Photos: Cyril Peckham, PRM

bases. The next few years saw a gradual improvement in the Flight's fortunes. In April 1964 Spitfire PRXIX PS853 returned to the fold after being well looked after during its days as a gate guard with the Central Fighter Establishment at West Raynham and Binbrook. In 1965 the British Aircraft Corporation presented its Spitfire MK VB AB910 to the RAF, Vickers-Armstrong Ltd and the BAC having maintained the aircraft in airworthy condition since the late 1940s. AB910 was flown to its new home at Coltishall on 16 September 1965 by the famous Spitfire test pilot Jeffrey Quill and was a very welcome addition to the Flight.

1968 saw a period of high activity for the aircraft in the Flight, for during that year they not only performed their usual roster of air display appearances, but all three Spitfires and the Hurricane were used in the filming of the epic aviation movie *Battle of Britain* for which the Flight's aircraft operated out of Duxford, Hawkinge, North Weald and Northolt, even venturing to the south of France during August 1968 to complete the aerial dogfight scenes of the film. At the end of the filming schedule the Flight was to gain another Spitfire, this time a rare Mk IIA which had actually seen operational service during the real Battle in 1940. P7350 had been part of the RAF Colerne Museum for many years until it was surveyed by Simpsons Aero Services for possible use in the film. It was found to be in remarkable condition for its age and was restored to flyable condition at RAF Henlow prior to extensive use in the filming during 1968.

During March 1972 Hurricane LF363 was

joined by Mk IIC PZ865/G-AMAU. This aircraft (the famous 'Last of the Many') had been part of the Hawker Aircraft Company's 'Flying Museum', consisting of Cygnet G-EBMB, Hart J9941/G-ABMR and the Hurricane and as such these aircraft made several demonstration flights at rallies, garden parties and the like over the years. These continued until the gradual wind-down of the Hawker Company in the early 1970s. Hawker gave the aircraft a major overhaul and then presented it to the Flight on 30 March 1972, thus doubling the Flight's complement of Hurricanes.

In 1973 the Flight took on its largest aircraft to date, Avro Lancaster B1 PA474, or as it is known with the BBMF, the 'Bomber'. PA474 was built as a basic B1 reconnaissance/bomber for use with the Far East Tiger Force, a role which it never achieved. Instead it was re-modified as a photographic reconnaissance aircraft and was issued to No 82 Squadron of the RAF in 1948. PA474 spent the next four years undertaking a photo-survey of Africa, after which it was allocated to Flight Refuelling Ltd, moving on eventually to the College of Aeronautics at Cranfield. It was probably this move that secured the aircraft's long term future as it spent the next ten years as a flying test-bed for laminar wing research which was being undertaken at that time.

In 1964 the Lancaster was replaced by Avro Lincoln RF342 and PA474 was taken on by the Royal Air Force Air Historical Branch. After being flown to No 15 Maintenance Unit at Wroughton for repainting in wartime camouflage the aircraft

was flown to RAF Henlow to be placed in open store for the proposed RAF Museum at Hendon.

The following year No 44 Squadron at RAF Waddington, which was the first squadron to operate Lancasters during World War Two, offered to look after PA474 and possibly restore it to full airworthiness. The Lancaster was ferried to RAF Waddington on 18 August 1965 and the team of volunteers started work straight away. Two years of hard work culminated with the Lancaster flying again on 7 November 1967, having undergone what was virtually a total rebuild. The aircraft, after satisfying the test flight schedule, was painted in the markings of Sqn Ldr John Nettleton's aircraft on the famous Augsburg raid, coded KM-B. After gaining the required Air Ministry approval the Lancaster was flown by No 44 Squadron on the display circuit, crewed by No 230 OCU Hastings personnel from RAF Scampton, captained in the main by Sqn Ldr Ken Sneller, but operating out of Waddington.

In 1973 the Ministry of Defence, as the Air Ministry was now known, chose to pool all of its historic piston engined aircraft at RAF Coltishall and therefore the Lancaster joined the Battle of Britain Flight on 20 November 1973. With the addition of the Lancaster the name of the unit was changed to 'Battle of Britain Memorial Flight'.

Whilst with the BBMF the Lancaster has been subject to much improvement with the re-installation of a mid-upper gun turret, functioning bomb-bay doors along with many improvements to the interior, making the aircraft approximately 85 per cent representative internally and externally of a wartime Lancaster.

In 1976, with the need for more space at Coltishall, the BBMF moved to RAF Coningsby, Lincolnshire, where it remains to this day, having its own permanent hangar and office accommodation from which to operate.

In 1984 Spitfire XIX PS853 had to be grounded due to its Griffon 66 engine becoming time expired. The engineering team at BBMF then embarked on the major job of converting a Shackleton's Griffon 58 to fit the Spitfire airframe, whilst at the same time maintaining all the other aircraft in the fleet. This complex work was to take five years to reach fruition and the Spitfire emerged in superb airworthy condition again

Lined up on Duxford's runway Spitfire IIA P7350 is followed by the Lancaster. PRM



in 1989.

In 1987 Spitfire XIX PS915 returned to the Flight after being given a similar Griffon conversion as PS853, although this time the work was carried out by British Aerospace at Warton and Salmesbury.

Alongside the Spitfires, Hurricanes and Lancaster are two more aircraft on strength to the BBMF. These are not display aircraft but support and training machines. The twin engined Devon C2 VP981 is used as a 'mother ship' if a solo fighter or pair of fighters have to display on their own, in which instance the Devon is used to carry the engineering team and sometimes act as navigator aircraft. The Devon is also used by the Lancaster captain to maintain his currency on multi-engine aircraft, the Lancaster being too precious for this exercise. The other aircraft with the Flight is the DHC Chipmunk T10 WK518. This small single engined trainer enables the fighter pilots to keep up their 'taildragger' time without recourse to using the Spitfires or Hurricanes. The Chipmunk is also used as a trainer for new pilots on the Flight, as most pilots have been trained on and are used to tricycle undercarriage jet aircraft. Sometimes the Chipmunk will be used to take a look at a display site the BBMF have not previously performed at, just to check on any obstacles that may have to be taken into consideration before the Flight's aircraft arrive.

Maintaining the BBMF's fleet of irreplaceable and virtually unique aircraft are a small but very dedicated band of 18 full time engineers led by the BBMF Engineering Officer, Warrant Officer Barry Sears, who has served with the RAF since 1956, joining the Flight as Engineering Officer in May 1985. All the engineers have volunteers to serve on the Flight, some of them are on their second or third tour, but all of them willingly work all the extra hours needed to keep the aircraft serviceable for the myriad of flying demonstrations that the BBMF perform each year. Some of them fly to the display sites in the Lancaster or in the Devon, sometimes even travelling by road to ensure that the fleet has engineering support at all times.

Strange as it may seem the BBMF has only one full time pilot on strength, who is also the Officer Commanding BBMF. Currently the OC is Squadron Leader Colin Paterson who joined the RAF in 1957 (the same year as the BBMF was formed), having trained on the 'Percival Piston' Provost. After graduating from Cranwell in 1960 he flew Shackletons at St Mawgan and Gibraltar which has stood him in good stead for his current job of Lancaster Captain with the BBMF. During his career with the RAF Colin has been a Flying Instructor on Jet Provosts, Flight Commander on the Nimrod maritime patrol aircraft, CFI of the University of London Air Squadron, along with staff tours at No 18 Group and MoD in London. Since then he has served at Headquarters Central Flying School and Cranwell before taking over as OC BBMF in April 1988. During his flying career with the RAF, Colin has amassed over 6,500 flying hours so far.

It is the Officer Commanding BBMF that has the difficult job each year of deciding which displays the aircraft of the Flight will attend, whilst at the same time keeping the



The Flight's hangar at RAF Coningsby is open to the public on weekdays.

aircraft within their annual allotted airframe and engine hours. Each year the Spitfires have only 140 hours spread between the five aircraft. The Hurricanes have 100 hours between the two aircraft and the Lancaster has 75 flying hours allowed. These hours must also take into account all transit flying, displays, air tests and any pilot conversion on to type that has to be done. Given those restraints it is nothing short of miraculous that the BBMF performs at over 130 events each year, ranging from a simple straightforward formation flypast over a village fete to a display day where two or three full displays have to be given in different parts of the country. All these situations have to be fitted into a coherent sort of display schedule whilst at the same time keeping all the aircraft within their allotted time limits.

Since April 1986 the BBMF hangar at RAF Coningsby has been open to the public as a major tourist attraction, members of the public having the chance to see the Flight 'at home'. This facility is operated jointly by the Lincolnshire County Council and the Lincolnshire Lancaster Association and is open each day from 1000 to 1600hrs, with the exception of public holidays and weekends. There is a small museum and a souvenir shop and guides are available for conducted tours around the Flight's hangar. Not all the BBMF aircraft can be guaranteed to be there at any given time as the operational nature of the Flight means that sometimes the aircraft may well be positioning to or from a display. On the other hand visitors may be lucky to see the Lancaster, Spitfire or Hurricane return from

a display, or depart from Coningsby to take part in a display.

Piloting the Spitfires and Hurricanes throughout the 1990 display season will be the BBMF's 'Fighter Leader' Sqn Ldr Paul Day AFC, who has been with the Flight since 1980, amassing over 600 hours on the Spitfires and Hurricanes. Alongside Paul will be Group Captain Martin Widdowson; Wing Commander David Moss, Sqn Ldr Allan Martin and Sqn Ldr Chris Stevens. Because of the high demand for BBMF fighters during this year's 'season', one of the Flight's Devon pilots, Sqn Ldr Jim Wild may help out from time to time on the fighters.

Crewing the Lancaster this 'season' will be OC BBMF Sqn Ldr Colin Paterson, as Captain, along with Co-pilots Sqn Ldr Rick Groombridge and Flt Lt Mike Chatterton. Navigators Sqn Ldr Tony Down (now in his eighth year with the Flight), Sqn Ldr Mac McKendrick and Flt Lt Doug Eke. Air Engineers will be Master Engineer Steve Sloan, Flt Lt Ian Leddra and Sgt Mike Moxon.

It is quite fitting and right that the Royal Air Force should maintain in flying condition the aircraft of the Battle of Britain Memorial Flight to act as a reminder of the ultimate sacrifice made by so many people during World War Two so that we can enjoy the freedom that we have today. The aircraft of the BBMF will without doubt be the highlight of many air displays during this, the Battle of Britain 50th Anniversary year. As those famous shapes and sounds of the Spitfire, Hurricane and Lancaster fly across our skies this year, the BBMF motto becomes much more poignant, *Lest We Forget*.

The BBMF in characteristic formation over a major air show. PRM





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THE RAF BENEVOLENT FUND'S
BATTLE OF BRITAIN
50TH ANNIVERSARY APPEAL



THE ROYAL AIR FORCE BENEVOLENT FUND

The Royal Air Force Benevolent Fund was founded in 1919 by Marshal of the Royal Air Force, Lord Trenchard. The objective of the Fund is to alleviate distress and need, actual or potential, amongst past and present members of the RAF, including the Women's Services, the Royal Auxiliary Air Force, the Royal Air Force Reserves and their widows, children and other dependants.

The scope of care is broad, and falls into four main areas of help: residential and convalescent homes; housing; education and general welfare.

Since its inception the Fund has helped over 750,000 beneficiaries. In 1988 more than £8.6 million was received by nearly 16,000 beneficiaries, compared with less than £1.5 million in 1977.

Of the sums awarded in 1988, 32% went to widows, 35% to the disabled, 24% to serving and former RAF personnel, and 9% towards helping with the education of their children.

Between 1939-1945 an additional 1.75 million people became eligible for assistance from the RAF Benevolent Fund. The number of surviving World War Two veterans turning to the Fund for help is climbing towards its peak, and the Fund's resources are being stretched to breaking point.

This has meant that in recent years, the Fund has fallen into deficit against ordinary income. It is projected that this will become a cumulative £36 million by 1996.

Of every £1 of the Fund's total income, at least 85p goes directly to those in need.

In addition to the relief of immediate distress and need, the Fund runs several schemes for those who need more extensive, or longer term help.

Some of the most urgent needs centre around two homes, Alastrean House, Aberdeenshire and Princess Marina House, Sussex, which, in particular, is in need of repair and renovation. They provide residential accommodation for disabled and elderly former servicemen and women of all ranks, and their dependants.

Duke of Kent School, at Ewhurst, in Surrey, is an independent preparatory boarding school administered by the Fund. Its primary aim is the education of children of officers and airmen who die or are severely disabled during or as a result of their service. These, the Foundationers, are given free places or substantial fee reductions.

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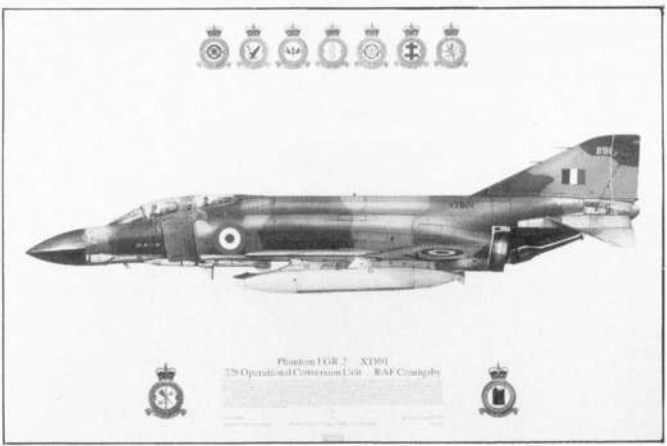
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FOR F4 READ F3

Lindsay Peacock

Those who attended the annual Battle of Britain open day and air display at RAF Leuchars on 23 September 1989 cannot fail to have been impressed by many of the items that were on view. Strategic Air Command's collection of 'heavy metal' was, in terms of sheer size, the dominant feature of the ground exhibition, with the highlight being a Rockwell B-1B from the 28th Bomb Wing at Ellsworth AFB, South Dakota. Another popular and for some, nostalgic sight must have been Treble-One Squadron's handsome all-black Phantom FG1, complete with yellow trim on nose and tail. It provided a reminder of the halcyon days of the celebrated *Black Arrows* aerobatic team and its even more handsome Hawker Hunters.

Of much greater importance, however, was an item which appeared some way down the flying programme, although its significance may well have escaped the attention of many onlookers. It was the arrival, at 1530hr, of a pair of aircraft from RAF Coningsby. With the black and white checkerboard insignia of No 43 Squadron astride the pale pink and blue roundel and the celebrated *Fighting Cock* emblem proudly displayed on their fins, the appearance of two Tornados (ZE961/GA and ZE962/GB) effectively ushered in a new era at this Scottish base. RAF Leuchars had at last begun the process of converting its operational squadrons from the long-serving McDonnell Douglas F-4 Phantom FG1 to the Panavia Tornado F3.

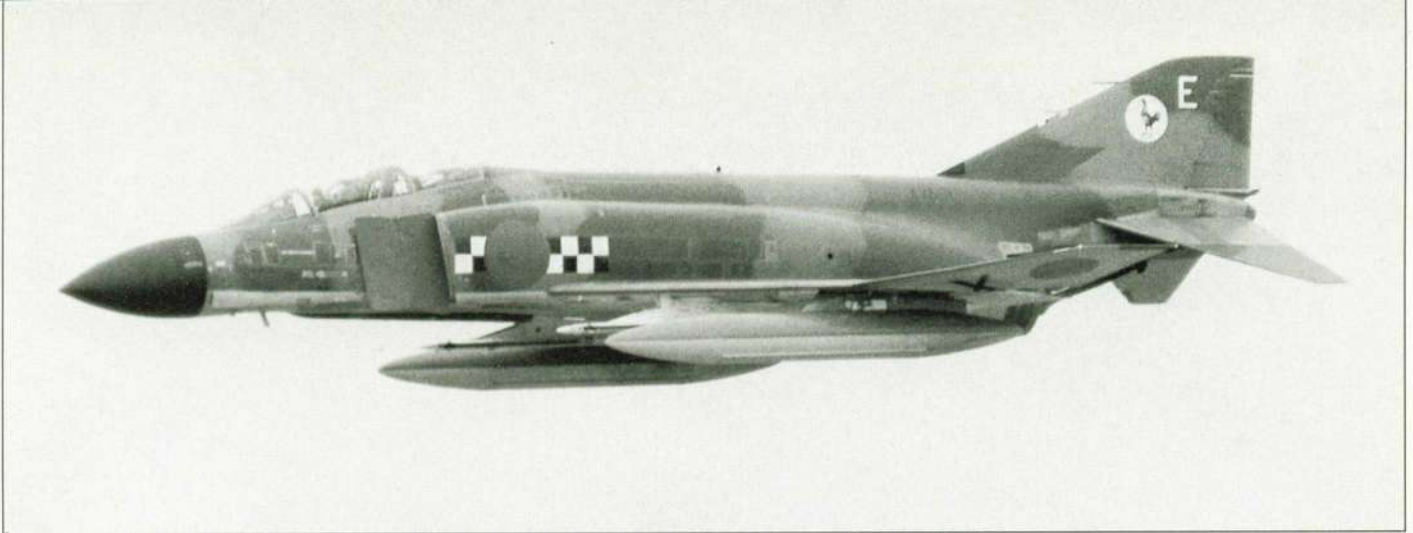
Although this event allowed station personnel to introduce this latest fighter to serve at Leuchars to local and not-so-local inhabitants, the duo which flew in from Coningsby were by no means the

first Tornado F3s to be seen there. Aircraft from other elements of the UK's air defence organisation have been periodic visitors, dropping in from time to time for fuel while the process of preparation also witnessed the appearance of other examples in the shelter complex which will eventually be No 43's permanent home. Belonging to other RAF units, they were present on a kind of 'loan' basis during much of the summer of 1989 so as to allow engineers and other key personnel to undergo 'hands-on' training while aircrew due for posting to the Fighting Cocks passed through No 229 Operational Conversion Unit's 'Tornado School' at Coningsby.

Despite all the publicity surrounding the events of 23 September, station personnel at Leuchars actually got their hands on the first of their 'own' fleet of aircraft exactly one month earlier, on 23 August, when a single Tornado F3 was delivered direct from the British Aerospace factory at Warton. That arrival was a very low-key event, for the aircraft involved (ZE963), lacked unit insignia and very quickly disappeared into the depths of the Aircraft Servicing Flight (ASF) hangar where it was pressed into service as an engineering training aid to familiarise the staff with the intricacies of the new fighter.

If 23 August was significant in that it provided tangible proof of the coming of Tornado to Leuchars, it was by no means the first manifestation that a new era was about to dawn, for preparatory work actually pre-dated that event by a not insignificant interlude. Indeed, the arrival of the first aircraft may more accurately

Above: The first of No 43 Squadron's Tornado F3s arrives at Leuchars on 23 September 1989. RAF Leuchars



No 43 Squadron operated Phantom FG1s at Leuchars for nearly 20 years from 1 September 1969. PRM

be said to have signalled the end of one element of the planning process and paved the way for the next stage.

In terms of investment, readying Leuchars for its new equipment has been a significant business, with close to £6 million being expended on various aspects of the essential support infrastructure. The preparatory process predated deployment by almost two years. Although many of the signs were by no means obvious, those who have an intimate association with Leuchars cannot fail to have noticed that change was in the wind — all one had to do was count the contractors' lorries as they came or went or study the piles of rubble that appeared at various locations as footings were excavated for new structures and facilities.

By the summer of 1989, most of this work was complete and some of the new additions to the Leuchars skyline were in daily use. Foremost amongst these is the Rediffusion/Singer Link-Miles Tornado simulator which came on line in early summer. Sited close to the existing Phantom simulator, pending the arrival of

qualified aircrew from No 229 OCU it was initially used by senior station staff and this interval was probably quite valuable in that it provided a 'shake-down' period for the sophisticated equipment.

Elsewhere, a new engine test facility was constructed. Well aware of the fact that the RB199 is not exactly the quietest powerplant at the present time, station personnel are acutely alert to the need to limit noise pollution and are most anxious to remain 'good neighbours' to the local communities in Leuchars village and at nearby St Andrews. Use of the new detuner will go some way towards reducing the impact of noise although it will not entirely eradicate it.

With regard to those airfield facilities that are directly concerned with actual operations, the advent of the Tornado F3 has caused little change. The load-bearing capacities of the existing taxiways are perfectly adequate for the new fighter, as also are the two runways. In the normal course of events, the east-west runway (09/27) will continue to be the primary but Tornado will be able to operate quite safely from the cross runway (04/22). At

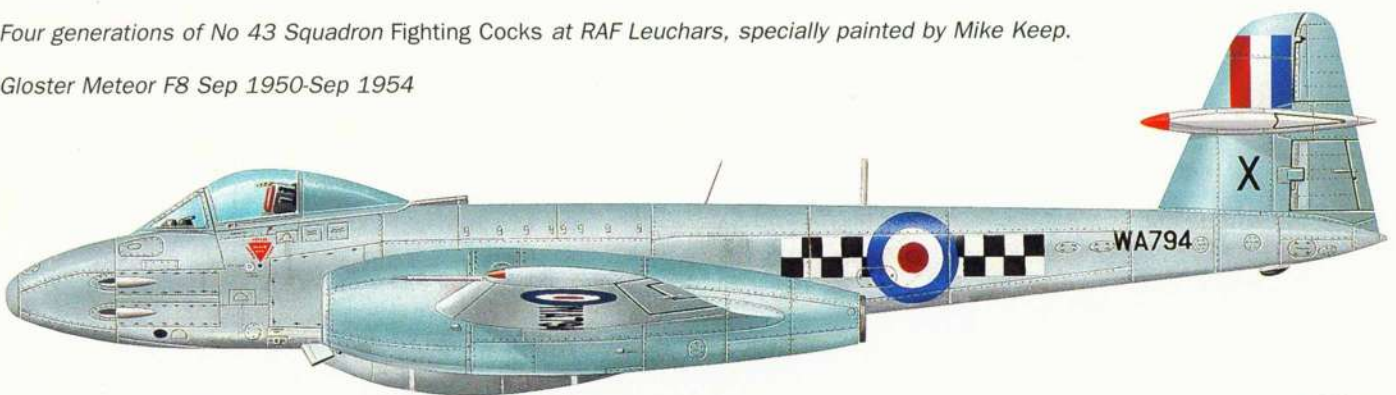
just 4,803ft in length, this is much shorter but it has regularly been used by the Phantom, although that type must engage the cable if it is to avoid the risk of over-running on landing. With Tornado, which has a thrust-reversal facility, arrested landings will henceforth be the exception rather than the rule when using the shorter runway.

Hardened shelter accommodation is also fully transferable and each of the two squadron sites should encounter no difficulty in housing a full complement of aircraft, especially in view of the fact that each shelter can contain two Tornados. This is an aspect that may well come in useful from time to time since it will permit shelter renovation to be accomplished without too much disruption to normal operational activity. Throughout the Phantom era, No 43 Squadron occupied the HAS site to the north of runway 09/27 with No 111 Squadron residing in the site to the south and this distinction will continue with the Tornado.

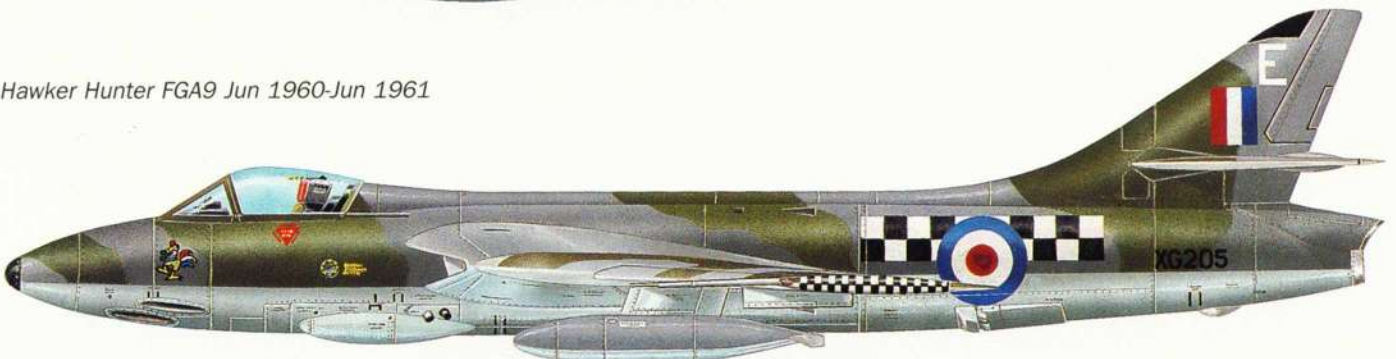
Further investment concerned the provision of a new electronics test and check-out facility. The Tornado's avionics

Four generations of No 43 Squadron Fighting Cocks at RAF Leuchars, specially painted by Mike Keep.

Gloster Meteor F8 Sep 1950-Sep 1954



Hawker Hunter FGA9 Jun 1960-Jun 1961



array is rather more sophisticated than that of the Phantom. Nonetheless, the maintenance and rectification process is probably simpler to accomplish by virtue of the latest hi-tech diagnostic equipment which can quickly identify faults in defective items. Renovation of one hangar was also undertaken and this will henceforth be home for the Leuchars Tornado Aircraft Servicing Flight (TASF) which will look after second-line maintenance requirements that cannot be satisfied at squadron level and which do not warrant attention at RAF St Athan where third and fourth-line maintenance is undertaken or British Aerospace at Warton.

As in the past, day-to-day routine first-line maintenance work will continue to be performed at squadron level. It is in this area that the greatest benefits will probably be felt since the Tornado is less labour-intensive and less demanding of engineering expertise. Many of the more complex items of avionics equipment are line-replaceable units which in the event of failure, squadron personnel will simply 'pull' out the defective item and substitute a serviceable component, leaving the job of repair to specialists in the electronics test and check-out facility at TASF.

All of this naturally dictates that ground support personnel receive a considerable amount of tuition in the art of Tornado 'tweaking' which is one reason why aircraft were made available for 'hands-on' training prior to the delivery of Leuchars' own F3s. In addition, members of the engineering support team also had to study the complexities of Tornado in the classroom, training being a carefully balanced mix of theoretical and practical matters designed to provide a suitably qualified ground team ready and able to support flight operations once the build-up began in earnest.

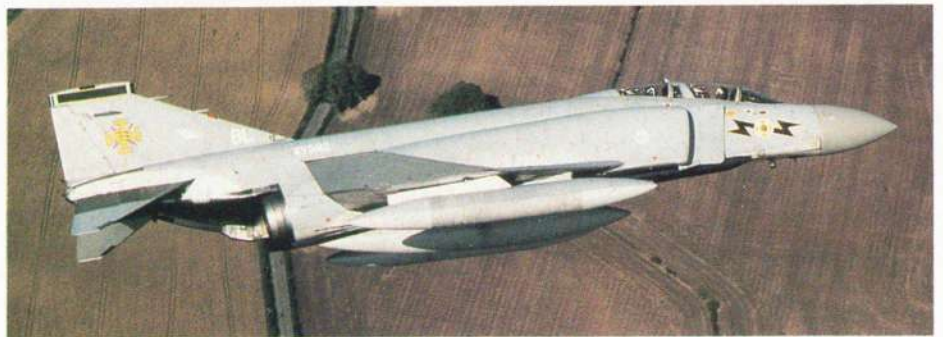
Although the flying build-up was publicly

launched by No 43 Squadron on 23 September, Once again, the preparation began well in advance of that date, when aircrew reported to join the *Fighting Cocks* destined to No 229 OCU at Coningsby.

Against that background, Phantom operations by Nos 43 and 111 Squadrons continued more or less unabated from Leuchars until early July 1989. At that time, No 43 began curtailing its activities in anticipation of standing down on the last day of the month. Of the Phantom FG1s previously operated, a few were passed on to Treble-One, but most were consigned to temporary storage pending a decision on their ultimate fate, something which has still to be decided at the time of writing.

Under the leadership of Wing Commander Moir, No 43 Squadron is now well advanced in the task of working up to combat-ready status, an objective that is expected to be achieved in the first half of 1990 when the unit will have received its full complement of about a dozen Tornado F3s.

Led by Wing Commander Hanlon, Treble-One continued to operate the trusty Phantom FG1 for the remainder of 1989 and on into 1990. As well as picking up a few 'hand-me-down' aircraft, it also gained an infusion of new personnel, with several former *Fighting Cocks* simply moving across the airfield to No 111's site following the stand-down on 31 July. With effect from 1 August, No 111 had sole responsibility for fulfilling Leuchars' Quick

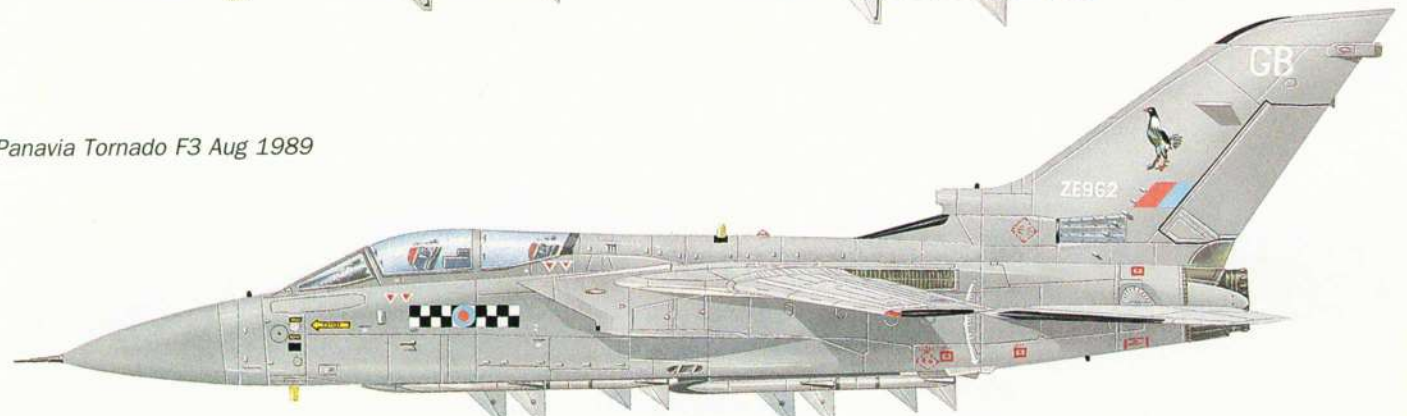


Top: Colourful Phantom FG1 of Treble-One Squadron. John Dunnell Above: No 111 Squadron will retire its Phantoms later this year. Lindsay Peacock

McDonnell Douglas Phantom FG1 Sep 1969-Jul 1989



Panavia Tornado F3 Aug 1989





GA touches down at Leuchars. T Malcolm English



High over the North Sea, the Fighting Cock's F3s. Keith Wilson/Aviation World

Reaction Alert (QRA) obligations, maintaining two aircraft and crews at readiness around the clock. That responsibility was, however, relatively short-lived, with the 'Q' commitment being transferred elsewhere later in 1989 and it will not return to Leuchars until such time as No 43 Squadron is again declared operational and fully combat-ready.

By then, the re-equipment of No 111 should itself be well advanced with current projections anticipating a return to full operational capability before the end of 1990. At that time, the five Tornado squadrons distributed between Leuchars (Nos 43 and 111) and Leeming (Nos 11, 23 and 25) will be responsible for providing the QRA cover for the entire northern half of the United Kingdom Air Defence Region while elements at Coningsby (Nos 5 and 29 Squadrons, also with Tornado F3s) and Wattisham (Nos 56 and 74 Squadrons with Phantoms) look after the southern area.

In summing up what has obviously been an ambitious undertaking, the Station Commander at Leuchars, Group Captain Tony Bagnall, was quick to praise the role played by outside contractors, affirming that they had provided 'good support' throughout. He also emphasised that those responsible for overseeing the modernisation programme had 'got the forward planning right' with the result that aircrew coming in to join the rejuvenated squadrons would be fully worked-up in the shortest possible time, with the least difficulty and with the absolute minimum of impact on operational readiness.

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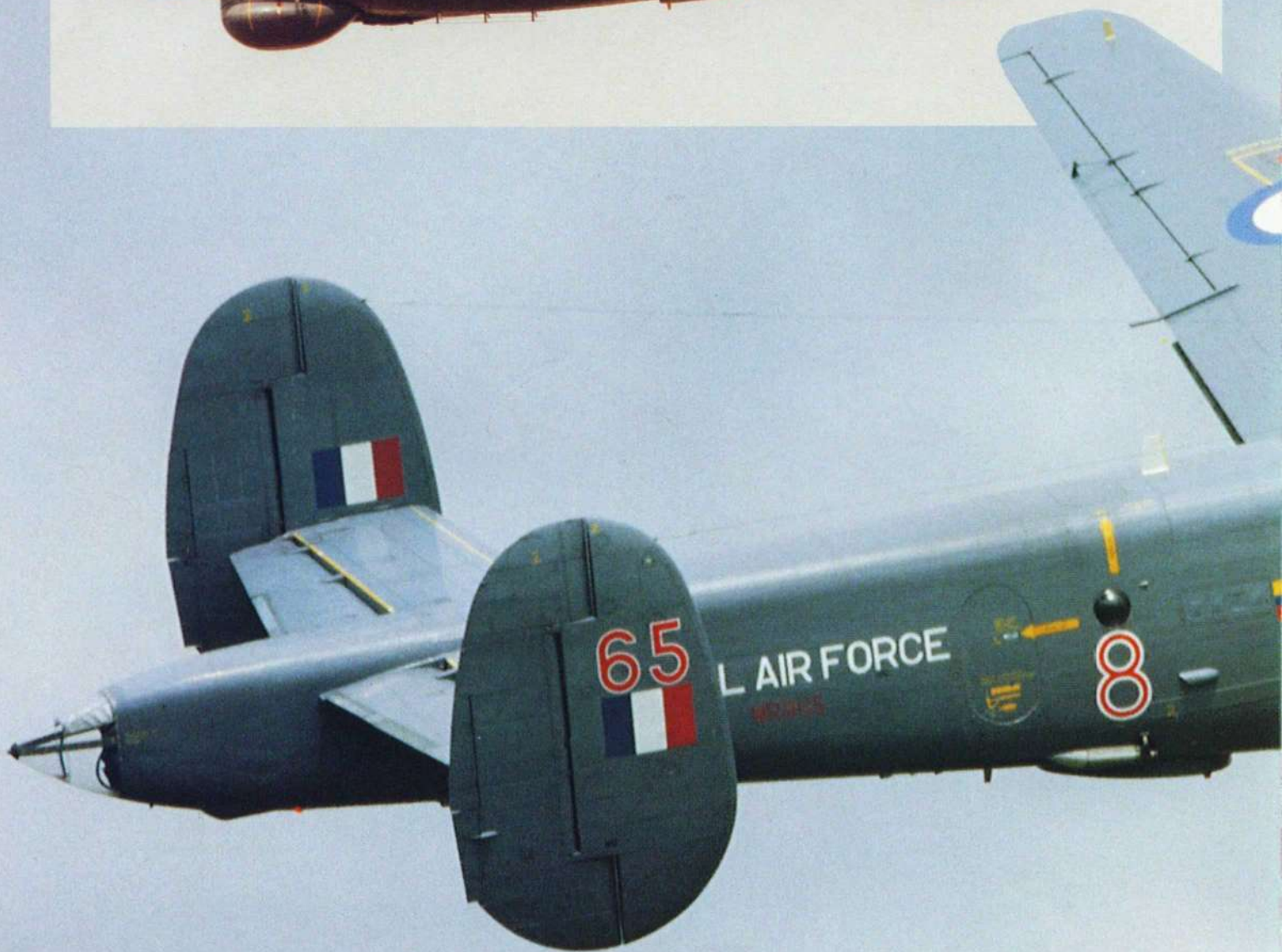
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DISPLAYING THE Shackleton

Flight Lieutenant Roger Read,
No 8 Squadron,
RAF Lossiemouth



The growl of four Griffon engines with their contra-rotating propellers and the rather ungainly shape of the old grey lady still stirs many hearts. Forty-one years old and still operational, the Shackleton has perhaps more admirers now than she has ever had. To many aircrew she was a dirty, noisy, smelly and supremely uncomfortable home for up to 15 hours at a time. To the groundcrew she was an idiosyncratic, outdated, uncomfortable beast to work on. Nevertheless, everyone loved her — and they still do.

It has been my privilege to have been the Shackleton display pilot for five years. No-one knows better than I do how dirty, smelly, noisy and uncomfortable she is. But equally, no-one knows better than I

do what a wonderful old aircraft she is to display. It is a real pleasure to be able to fly an aircraft which needs little help from the pilot to bring out the best in her.

How do you start designing a display for an aircraft like the Shack? The first thing is to decide on what manoeuvres the aircraft can fly. Obviously, with an older, slower, heavier aircraft, aerobatics are out. No doubt a roll off the top in such an aircraft would look most dramatic but would be nothing compared to the smoking hole in the ground shortly afterwards! Besides, I am in the business of keeping the crew alive and, from a more selfish point of view, looking after my own neck. Therefore, leaving some of the more interesting manoeuvres to those

more able to perform them, we are left with a handful of what are, on the face of it, rather prosaic actions: steep turns, fly pasts with the bombdoors open, with the wheels down and with a 'clean' aircraft. Not a lot to be going on with I am sure you will agree, but I have a couple of aces up my sleeve — of which more later.

One major point in the aircraft's favour is its popularity. For the devotees of the Shackleton just a single flypast would be considered a great treat, so two or three would make their day. However, for the vast majority of the public, this would hardly make them raise their heads from the consumption of beefburgers and ice creams. Therefore, something more dramatic must happen to capture their



Above and previous pages: Airshow action from the Shackleton AEW2 flown by Fit Lt Roger Read, No 8 Squadron, RAF Lossiemouth. Photographs: PRM, John Dunnell, Graham Finch, Daniel March

attention. Now I play my first ace . . .

One of the advantages of a propeller driven aircraft over a jet is that when you fully close the throttles, the props act like massive airbrakes and practically stop the aircraft dead in mid air or, by virtue of the tremendous braking effect, allow the aircraft to be pointed downwards at a very steep angle. Not only that, but the sound of the engines dies away quite abruptly. The combination of these two effects provides quite a heart stopping entry to the arena: the sudden silence arrests the

ice cream consumers in mid lick, and, looking up, they are confronted with the spectacle of a large aircraft pointing dramatically at the ground. This serves to grab a fair amount of attention right at the beginning of the show.

Having grabbed the attention of some of the crowd, the next task is to keep it — easier said than done. The sound of the aircraft, so refined after the painful chest-hammering blast of the jet-borne fraternity and yet more demanding than the polite putter of light aircraft when coupled with the sheer size of the Shackleton, has already whetted their appetites. The top view of a large aircraft can be quite dramatic, as can a full frontal view. So the aim of the next part of the display is to point towards the crows as much as the regulations permit, and to keep on a fair amount of bank.

Several steep turns help to show the upper surfaces, while the flypasts enable most of the crowd to get at least one head-on view.

For the finale there is the other ace to be played. Everyone expects a jet to point towards the sky fairly regularly. However, a steep climb from a 'heavy' is somewhat unexpected. A Shackleton appears to be fairly leisurely, even when flying fast, so it is quite easy to build up plenty of momentum and then convert this into a steep climb out to end the show. A dramatic start and a dramatic end.

One aspect of all display flying which is frequently taken for granted without thought by both spectators and sometimes organisers alike, is the display start time. Unless one is flying an aircraft which takes off straight into the display, it is usually necessary to tailor one's arrival time so as to start bang on time. This aspect often causes the most grief and heartache to the display pilot. No matter how well planned the arrival is, there is



Left: Roger Read proudly displays a trophy awarded to the Shackleton crew after an air show at Sanicole, Belgium. PRM

frequently a slight glitch. Either the previous display slot is overrunning and you don't find out until you are about to start, or, you are still several miles out on the run in when you are told that the display line is yours! Both these situations occur with monotonous regularity, and, unfortunately there is little either organiser or participant can do about it except grin and bear it and hope that nobody notices.

I have already mentioned the nose dive at the start of the display. It looks pretty exciting from the ground, but let me assure you, it looks even more dramatic from on board the aircraft. This is particularly true from right up in the nose seat where the navigator sits during the display. As the aircraft tips forward, all he can see is the world rushing up towards him at a rate of knots — quite invigorating when you are used to it but rather startling for the first time. Early one season, when I was still working up, I had briefed a new navigator on his duties which included telling me to begin the display as the aircraft passed over a particular spot on the ground. Unfortunately I had forgotten to warn him how the display started. In a coolly professional voice he called 'Commence now . . . now . . . now'. There then followed a short pause. As the full effect of the nose dive struck him there came a strangled cry about two octaves above his previous utterance. Gone was that professional manner. All that was left was pure gibberish! It took him at least ten minutes to recover his cool. Since then, I have made sure that all crew members are well aware of what to expect.

There is one particular aspect of displaying the Shackleton which I particularly enjoy. Being relatively slow, it is quite easy to keep the aircraft well in view throughout the display. This is especially noticeable at some of the smaller venues where we have displayed. It is at the smaller venues that the size of the aircraft is a real asset. At most of these places the display participants tend to be small 'puddle jumpers' so, when a large aircraft appears at close quarters, it immediately commands attention from the crowd and often steals the show. To understand this imagine the effect of the



appearance of a large aircraft at very low level right over your house or garden. It would be a most arresting sight and no doubt you would remember it for some time afterwards. Thus, the arrival of a Shackleton over the local carnival, or even over a small grass airfield, is likely to have a similar effect on the viewers.

It is frequently at these smaller airshows that some odd things occur. In 1988, I was carrying out a display at Old Warden, for the Shuttleworth Collection (No, the aircraft is not quite old enough to qualify for acceptance by the Trust!). As we started our run in, it became obvious to us that a very large thunderstorm was about to break right over the display site, so we warned the organisers by radio. Because of the risk of lightning strikes they decided to evacuate the tower, leaving us to avoid the storm as best we could. About ten minutes later they came back on the radio to tell us that the storm was clear of the airfield and we could commence our display. Unfortunately, by this time the storm was directly between us and the airfield, obscuring our view and preventing us from running in for several minutes.

Eventually the weather cleared sufficiently for us to commence our display over a somewhat damp crowd. When we had finished, we heard the Battle of Britain Memorial Flight telling the organisers over the radio that, because of the storm, they would not be able to get to the airfield to display. At this stage we had noticed a narrow lane of clear sky through the clouds which now totally surrounded the airfield and, having found out where the BBMF was, we were able to

direct them to the entrance of the lane. Once we saw them approaching the lane, we were able to lead them back through the storm and over the airfield, giving the crowd the stirring sight and sound of a Shackleton closely followed by the Lancaster, Spitfire and Hurricane in an impromptu but most effective flypast.

One of the favourite questions from the public who see the contra-rotating props for the first time is: 'Are there two engines behind each propeller?' A sensible question because the Fairey Gannet had just that layout. However, the answer is of course, no. There is only one engine behind each set of props, and some fairly complicated mechanics to drive them in opposite directions. It is of course this particular layout, with the propellers rotating in opposite directions, that gives the Shackleton its distinctive sound.

One of my favourite questions however, came from an American serviceman at Mildenhall some years ago, who, having looked long and hard at the aircraft came up to me and asked 'How the Hell did you get that thing here?' His look of total disbelief when I told him that we had flown it in defies description. His eyes opened wide and his mouth dropped. 'That thing flies?!' I assured him that it did indeed fly and a few hours later, after the display he sought me out again. 'Well! Jeez! I'd never have believed it', he said. 'And it flies pretty Goddam good too!'

It's comments like that which make all the frustrations, hard work and time away from the family display flying all seem worthwhile.





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Introducing the TUCANO

Wing Commander Peter Stannard, Chief Instructor of No 7 Flying Training School, RAF Church Fenton



Above: The Jet Provost T3 introduced all-through jet training in October 1959. PRM
Below: Pilatus PC-7 one of the original 23 proposals for a JP replacement. PRM
Bottom: Embraer's EMB-312 Tucano powered by a 750 shp PT-6A turboprop. PRM



Just before Christmas 1989 the student pilots of No 42 Course at No 7 FTS, started their basic flying training at Church Fenton and became the RAF's first students to undergo pilot training on the new Shorts Tucano T1. This marked the end of the aircraft's long introduction to RAF Support Command as successor to the Jet Provost T3A/T5A. At this point I began to find out how well I had done during the 3½ years I had spent in my previous job as leader of the Tucano Course Design Team at RAF Scampton. Before I detail how the Tucano will be used for Basic Flying Training (BFT) I will answer the inevitable question — why has it taken so long to get it into BFT service?

Perhaps I should begin by dispelling some of the myths that have been generated about the aeroplane over the last six or seven years. The RAF introduced all-through jet training with the Jet Provost T3 in October 1959 with the aim of teaching students to fly the type of aircraft then in front-line service. In all of its marks the JP has proved to be robust and reliable. However, it was designed for training pilots for an air force which then operated mainly at medium and high levels, whereas the increased emphasis on low-level flying over the past two decades has brought the JP down to fly much lower on its training tasks and accelerated the consumption of fuel and the airframe fatigue life. By the early 1980s the JP was nearing the end of its fatigue life

and the 50s technology Viper engine, with its horrendous fuel burn by modern standards, was proving increasingly costly. At the same time the RAF's front-line aircraft were becoming easier to fly although more difficult to operate because of the increasing complexity of on-board systems. Therefore, a training aircraft with modern flying characteristics, space for more sophisticated radio and navigation equipment, a good low-level performance and above all fuel efficiency was needed. This prescription effectively ruled out refurbishment of the Jet Provost fleet and a replacement had to be found.

As there was no turbojet available at the time with the required fuel efficiency and operating costs, it was decided to look at turboprop power for the new trainer. The JP's fuel limitation (just 40 minutes at low-level) had to be avoided, so the outline specification (AST 412), issued to the industry in 1983, called for an aircraft able to fly two one-hour sorties with sufficient fuel for a 100-mile diversion plus 10% reserve. Although side-by-side seating had been the preferred configuration since 'Piston' Provost days, a tandem layout was chosen, as this was more in keeping with the Hawk advanced trainer and the centre-line seating of the RAF's front-line types, giving the student pilot a much better all-round view. Side-by-side seating has been more of an advantage to the instructor than the student! In terms of speed a 210kt

groundspeed was originally chosen as it was thought that turboprops would be limited to about 240kt. In practice this figure turned out to be conservative so a 240kt low-level cruise was eventually specified, together with a climb from brakes off to 15,000ft in under seven minutes. The Air Staff Requirement issued in early 1984 went on to require a strong airframe, stressed to +6g/-3g, a service life of 12,000hr over 20 years, with a ground level/70kt ejection seat — to cater for those aircraft that do not make 12,000hr!

Of the 23 original proposals for the RAF's new turboprop trainer, just four designs reached the detailed evaluation stage — the Anglo-Swiss BAe/Pilatus PC-7/PC-9, the Anglo-Brazilian Shorts/Embraer Tucano; the UK Hunting Turbo-Firecracker and the Anglo-Australian Westland/A-20. The latter could only be assessed on paper, as it had yet to fly, but the other three were evaluated at Boscombe Down by a team from the A&EE and the RAF Central Flying School. In December 1984 the MoD announced that the PC-7/PC-9 and Tucano had reached the final stage of selection.

In response to the clear performance advantages that the PC-9 was showing over the EMB312 Tucano, Shorts produced its final proposals with a considerably modified aircraft. The 750shp Pratt & Whitney PT-6A was replaced by a 1,151shp Garrett TPE331-12B turboprop which would

on 21 March 1985 that the Jet Provost replacement was to be the Shorts Tucano.

This 'off-the-shelf' aircraft was to be built at Belfast, with the first aircraft scheduled to be delivered to the Central Flying School (CFS) at Scampton in January 1987 and enter service with No 7 FTS at Church Fenton the following autumn. The last of 130 Tucanos was to be delivered by mid-1991. This tight programme clearly failed to anticipate the major task that Shorts was facing — a major re-design of the EMB312 while at the same time putting it into full scale production. The EMB312's forward fuselage had to be deepened to take the larger engine; the whole airframe had to be strengthened to meet UK military aircraft requirements; the fin area had to be increased by the addition of a dorsal extension to give greater directional stability with the higher power; being heavier and with a faster touch-down speed the Tucano needed a new undercarriage; the cockpit had to be re-designed to accommodate the new avionics and instrument panel; a completely new air conditioning system was installed and, to meet the bird-strike risk at low-level, a new two-section canopy had to be fitted. Today's Tucano T1 is over 80% UK design which is a far cry from the trainer first submitted to meet AST412 and certainly a very long way from being 'off the shelf'. Shorts are to be congratulated on their achievement of incorporating the many

was to be used. Would we simply 'rub out' JP and 'type in' Tucano on exactly the same course? I was given the task in April 1986 of heading the Tucano Course Design Team, which was set-up as a lodger unit at RAF Scampton, where we worked closely with the CFS for the next three and a half years. Our brief was to look at what was being done in basic and advanced flying training to see how the new aircraft could be used to produce pilots better suited to meet the needs of the front-line operational squadrons through the 90s and on into the next century. We were told to be 'revolutionary' and not just evolutionary.

In simple terms what the TCDT did was to decide what and how we teach in Ground School and with what aids; define and procure this package; decide what sort of cockpit procedures trainer was required and procure it; establish how to make best use of the simulator; produce all the Ground School notes; learn how to fly it ourselves then write the flying instructor (QFI) and student handbooks. We were given three hours flying at Boscombe Down in February 1988 and four months later our first aircraft arrived at Scampton.

This Lincolnshire base has had, and will continue to have, a major role with the Tucano. Every new aircraft is delivered from Shorts to Scampton for its engineering clearance. Although it took up to eight weeks to get the early production aircraft into service, that has been cut now to about one week, as the engineers become more familiar with the aircraft, which are coming off the production line at a higher modification state.

It was soon apparent to us that the Tucano's tandem layout was going to be a significant bonus to the student but would make the instructor's task more difficult. The student has a better all round view than in the JP and this is particularly helpful for lookout, low-level navigation, formation flying and aerobatics. Because the cockpit wraps around the pilot he has everything to hand, as it is in all fast jets and is much better for the student on solo sorties. Also during instrument flying all of the instruments are directly in front of him and not offset to the right like in the JP. However, the QFI can only see the top of the student's bone-dome and obviously has much more difficulty in monitoring what he is doing and cannot actually demonstrate techniques. This means that the instructor must 'know' the front cockpit in great detail so that he can verbally explain things to the student rather than showing him. Finally, the QFI will have to be far more aware and develop special skills to discover what the student is actually doing.

The TCDT felt that a different approach was required in the training course to assist the QFI and to ensure that the student is 100% cockpit literate when he first flies in the front-seat of the Tucano. To this end a new, realistic, software — driven, cockpit procedures trainer was specified. Seven of these trainers are being produced for use at the BFTSS and CFS and will be used particularly in the initial ground school phase.

It was the ground school training, both methods and materials, that the Team felt was most urgently in need of a total re-think.

Below: Shorts modified an airframe to take the 1,151 shp TPE331 engine. PRM Bottom: The Tucano in RAF training colours. PRM



improve the Tucano's low-level cruise speed and rate of climb appreciably. There was now little to choose between the two aircraft on paper but, because the PC-9 was actually flying and pilots are very cynical about 'paper aeroplanes', their 'popular vote' went to this aircraft. However, it was not to be the winner of the competition, with the Secretary of State for Defence announcing

re-design features yet still producing a basic trainer that so appreciably out-performs its predecessor. The pilots who have flown both the PC-9 and the Tucano T1 now mostly prefer the Tucano.

Having got what the Boscombe Down test pilots call 'a real boys own aircraft that will put the fun back into basic flying instruction', the next problem was how it



Above: The central Flying School's six Tucanos flying near Scampton. RAF Scampton



Left and below: Angles on the new Tucano. PRM

Bottom: Tucano T1 and Jet Provost T5A of No 7 FTS. PRM

The former JP course was centred around the use of self-taught, programmed learning packages, and there was no end-of-course exam to ensure that the student understood how all the individual parts were inter-related. Also the linear packages tended to be too simple and the supporting audio-visual material was of relatively poor quality and very dated. Furthermore, after initial officer training the BFTS groundschool is the student's first contact with the real Air Force and professional flying trainers, so the TCDT saw this as a positive point to start to develop a professional attitude towards aviation subjects in general. This could best be done by using aircrew as teachers in the classroom, replacing the old films by up-to-date video-tapes that can be taken away with them and scrapping the daily exam. Synthetic training aids such as a life-size, three-dimensional replica of the cockpit, that each student can have in his room, were introduced. This leads to the cockpit procedures trainer which in turn leads to the simulator.

The four-axis, realistic-feeling Tucano simulator will have a key part to play in the basic flying training course. Although we have used the Link trainer and a JP Instrument Trainer (JPIT) in the past, this is the first time that the RAF has used a flight simulator in BFT. It will greatly enhance the airborne instruction by virtue of the ability to be selective and re-teach those exercises where the student is having trouble and of course to introduce emergencies that it would be unwise to practice in the air. Although the simulator will not reduce the



flying hours it will make them much more productive.

Using modern computer techniques it has been possible to introduce a dedicated training aid for navigation and instrument flying. The TCDT developed the navigation instrument trainer (NAVIT) with the RAF School of Education and Training Standards at RAF Newton in response to requests from

the advanced flying schools for a better level of instrument flying and radio navigation. We therefore developed a microcomputer based model of the Tucano's blind flying panel to enable the student to practice instrument departures, en route flying using radio aids and pilot interpreted instrument recoveries back to base. The micro-based NAVIT will be used at all stages of the BFT

course. Again it has not replaced any actual flying hours but has made flying more productive.

When the TCDT finished its work at Scampton in October 1989, the next crucial stage in the introduction of the Tucano had already started. The instructors of the Standards Squadron at No 7FTS received their conversion training at the CFS, which included 20 hours flying, between 4 and 29 September. They then returned to Church Fenton and during the following month converted the QFIs of 'D' Flight onto the new trainer. In general the response of these former JP instructors to the Tucano was that they did not find the conversion all that easy, but they like the end result and are optimistic that the planners (and the TCDT) have got it right!

Seven students for the RAF's first Tucano BFT (No 42) Course arrived at Church Fenton in October 1989, having had a preliminary week in the usual way at the Aeromedical Centre at North Luffenham. They then had six weeks of intensive ground school preparation, which included just one familiarisation flight in a Tucano. After a week of exams the course departed for preparation of very different kind — a five-day combat survival course in a remote part of Northumberland.

Having survived these hurdles the students started their flying training with No 2 Squadron of 7FTS just before Christmas 1989. Ahead of them lay 110 hours in the Tucano (or 63 hours for those going onto helicopters) before splitting into multi-engine or fastjet courses, the latter

Operationally the Tucano is already proving its worth. Back-to-back one-hour sorties are being flown, with crew changes being made without the need for refuelling. It is welcomed by the local community as it is appreciably quieter on take-off than either mark of Jet Provost and the noise footprint is a fraction of the spread of its predecessor. Operating both types as we have done at Church Fenton since October 1989 underlines the 'friendliness' of the newcomer.

By late April 1990 all basic flying training at No 7 FTS was being conducted on the Tucano, with the last of the JP courses reaching their conclusion. Its introduction to the RAF College Cranwell (No 3FTS) will be with No 88 Course in December 1990, followed by No 123 Course at Linton-on-Ouse (No 1 FTS) in February 1992, by which time all 130 aircraft will have been delivered.

Until the arrival of the Tucano we had been operating a basic flying training aircraft, the Jet Provost, that represented the technology and thinking of the 1950s. In the Tucano we have an up-to-date aircraft that performs, within the limits of its slightly lower top speed, like a high performance aircraft. More importantly it has the handling

characteristics of a contemporary front-line aircraft with light, responsive controls and is easy to fly but has sufficient avionics to keep the student busy. We believe that the Tucano training course that the TCDT designed has the right balance between modern training technology and traditional teaching methods. Within a tried and tested syllabus and the inevitable financial constraints, we have managed to fine tune the ground school and flying course to use the new aircraft to its maximum potential and get the best from our students. However, it is early days yet so it will be some time before we know whether the efforts of Shorts and the many contributing manufacturers, the Tucano Course Design Team, the A&AEE test pilots, the Central Flying School and the personnel of countless other RAF units have been successful. There are glitches already showing up, both in technical, operating and training terms, but these must be considered inevitable with what has turned out to be such a major undertaking. Let us hope that in 20 years time the Tucano will be looked upon with as fond memories as the Jet Provost — I am convinced that it will.

Tandem seating gives the Tucano a more slender fuselage. PRM



The Jet Provost T5A will continue to fly on until 1992. PRM

continuing with 38 hours fast-jet lead-in flying. Although this first course did not have the benefit of the cockpit procedures trainer (CPT) or the simulator, as neither were in commission for the early stages, subsequent entries will be taking advantage of these important aids to keep to the planned flying hours. On the Tucano the first solo flight is reached after 8hr 15min flying (11hr 15min for those who have not gone through a University Air Squadron or the Elementary Flying Training Squadron), which is one hour less than the Jet Provost. Alongside this the student has up to six simulator sorties before flying solo. Despite having no CPT or simulator training Fg Off Nigel Williams was the first BFT student to fly solo in the Tucano, after only 7hr 55min.



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5. Closing date for the receipt of entries is 30 September 1990. The Concorde Experience Flight prize draw will be made on 10th October 1990 and the prize winner will be notified by post.
6. The prize winner's name together with the solution will be available from the Promoter's office, at the address below, on receipt of a stamped addressed envelope.

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MATCH THE NAMES COMPETITION

1. The Battle of Britain is commemorated in which month?
A. June B. July C. September
2. The famous Hawker aircraft that took part in the Battle of Britain was:
A. Hurricane B. Typhoon C. Tempest
3. Which airfield was a base for fighters defending London?
A. Biggin Hill B. Cranwell C. Heathrow
4. Who was the legless pilot who took part in the Battle of Britain?
A. Ginger Lacey B. Douglas Bader C. Stanford Tuck
5. What biplane aircraft was used to train Battle of Britain pilots?
A. Tiger Moth B. Magister C. Harvard
6. Which aircraft manufacturer designed and built the Spitfire?
A. Bristol B. De Havilland C. Supermarine
7. Name the Luftwaffe dive bomber used in the Battle
A. JU87 Stuka B. Focke Wulf 190 C. Fiesler Storch
8. What famous Rolls-Royce aero engine powered the Spitfire?
A. Mercury B. Merlin C. Jaguar
9. Which Bristol bomber was adapted as a fighter during 1940?
A. Brigand B. Blenheim C. Beaufort
10. Who headed RAF Fighter Command during the Battle of Britain?
A. Montgomery B. Harris C. Dowding
11. What Luftwaffe fighter had dog-fights with Spitfires and Hurricanes in the Battle of Britain?
A. Heinkel Helll B. Junkers JU88 C. Messerschmitt Bf109
12. Where is the RAF Museum's Battle of Britain Hall?
A. Lambeth B. Hendon C. South Kensington

Question	1	2	3	4	5	6	7	8	9	10	11	12
Answer	C											

Name _____

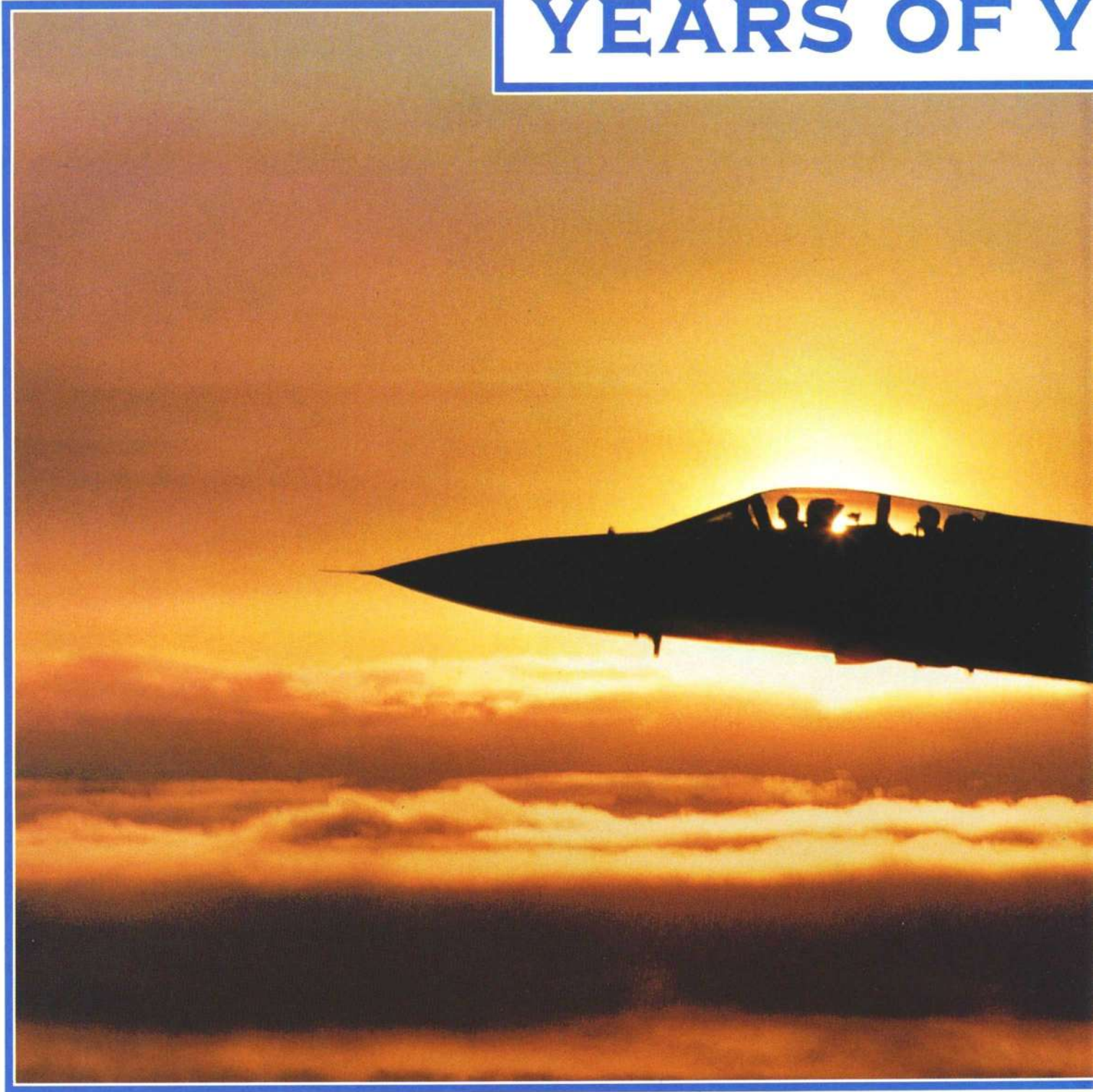
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THE UNWANTED WOODEN WONDER

John D R Rawlings recalls the wartime success story of the de Havilland Mosquito that first flew 50 years ago

Under its chief designer and owner, Geoffery de Havilland, the de Havilland Company had become one of the most successful exponents of the British aircraft industry between the wars. Whilst this reputation was built up on biplanes of conventional configuration, he had built several monoplanes of advanced design, including the DH71 Tiger Moth, the DH88 Comet (which won the 1934 England-Australia air race) and the DH91 Albatross, possibly the most beautiful four-engined airliner ever built.

In 1936 the Air Ministry issued a specification for a twin-engined medium bomber. It required long range, heavy bomb load and great defensive armament. De Havilland had different ideas and evolved from the Comet racer a twin-engined bomber that was so clean aerodynamically that its operational speed would pose insuperable problems; this aircraft had the type number DH98. It was designed to be built in wood so as to save strategic materials and it could be built by non-strategic labour in the furniture manufacturing industry. Geoffery de Havilland wrote to the Air Ministry in 1938 with his proposals but they refused to treat them seriously except for one man, Sir Wilfred Freeman, Air Member for Research and Development. He explored avenues by which the aircraft could be developed and eventually an order was given for one prototype, a photo reconnaissance aircraft under Specification B1/40.

A country house, Salisbury Hall, was taken over, six miles from Hatfield, and here this prototype was built under the design team led by R E Bishop. Very soon WW 2 broke out, giving de Havilland ideas for other uses for the DH98, but the project almost ended when Lord Beaverbrook became Minister of Aircraft Production for he tried to stop work on all aircraft but those actually in production. In spite of this the first

prototype was built and rolled out for engine runs on 19 November 1940. Six days later Geoffery de Havilland Jnr took this prototype, E-0234, into the air with its overall yellow colour scheme showing brightly on a murky day.

Because the design had such obvious potential the Air Ministry decided to order an initial batch of 50 aircraft, principally for service trials in a number of roles; photo reconnaissance, fighter, trainer and bomber. These first aircraft, including the prototype, were powered by Rolls-Royce Merlin 21s, and went to Boscombe Down where little notice was taken of them until flying commenced and then the resultant tests produced much enthusiasm and a flurry of activity from the Ministry. All was now set for its future use.

This was to be in three broad fields; photo-reconnaissance, bomber and fighter. First off were the PR aircraft, the first of which, W4051, took to the air on 10 June 1941: by the end of September five were in service with the PRU at Benson, having begun its operational career with a reconnaissance of Brest and the Spanish frontier on 17 September. The aircraft for this flight was W4055, flown by Sqn Ldr Rupert Clerke. From that moment on the PR Mosquito grew into an integral part of the PR force.

With the Battle of Britain still fresh in the mind the next important role was as a long-range fighter to fill the gap, especially in the night-fighter realm. The first fighter prototype (FII W4052) flew on 15 May 1941 and by the end of the year sufficient numbers had been delivered to form No 157 Squadron at Debden as the first squadron. It was operational by the Spring of 1942 and flying patrols against the German raids on provincial cities, termed 'Baedeker' raids. First victory was scored by the second Mosquito squadron, No 151, on 29 May 1942 when Flt Lt Pennington brought down

an He 111 into the sea after an attack on Grimsby.

With these two versions successfully launched, the role for which the Mosquito was originally designed, as a fast daylight bomber, now came into play. No 2 Group of Bomber Command had been suffering heavy losses to its Blenheims and it was a Blenheim squadron, No 105 at Swanton Morley, that received the first BIVs on 17 November 1941. The first bombs were dropped at the end of May 1942 during the Thousand Bomber raid on Cologne, each aircraft carrying 1,500lb of bombs. The squadron experimented with different ways of operating to find the optimum use, resulting in a daring September mission. On the 25th of that month four of the squadron's aircraft flew a daylight, low-level raid on Gestapo Headquarters in Oslo and accomplished a precision attack at ultra low-level. One aircraft was lost. It was clear that high speed was the type's finest asset and Ministry proposals to fit the Mosquito with defensive armament came to naught.

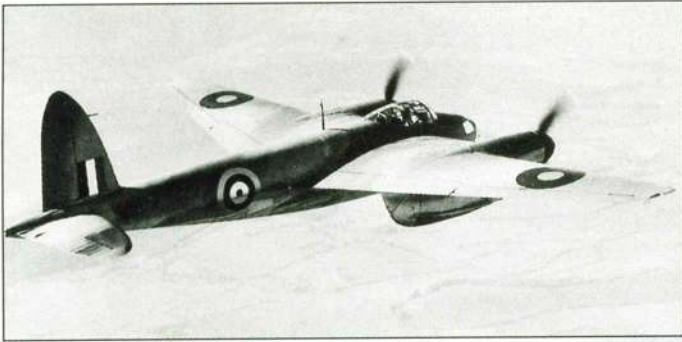
Probably the finest idea at that time was to produce the FBVI, by way of being a general purpose variant. This combined the gun armament of the FII (four 0.303 machine-guns in the nose and four 20mm cannon in the belly) with a 500lb bomb load in the belly and 250lb under each wing on racks. A MkIV, DZ434 was taken from the production line for this purpose and reserialled HJ662. This version became the most prolific of all those produced, serving in every field where the Mosquito was used. One of the new fields was that of night intruding. This had been the particular province of No 23 Squadron at Ford who found the Mosquito FII much superior to its Bostons and Havocs. With the FBVI it could add bombs to the havoc it wrought on enemy airfields, and this task was taken up later by other squadrons as well. By the end of 1942 the Mosquito was firmly established

The prototype Mosquito E0234 was rolled out on 19 November 1940.

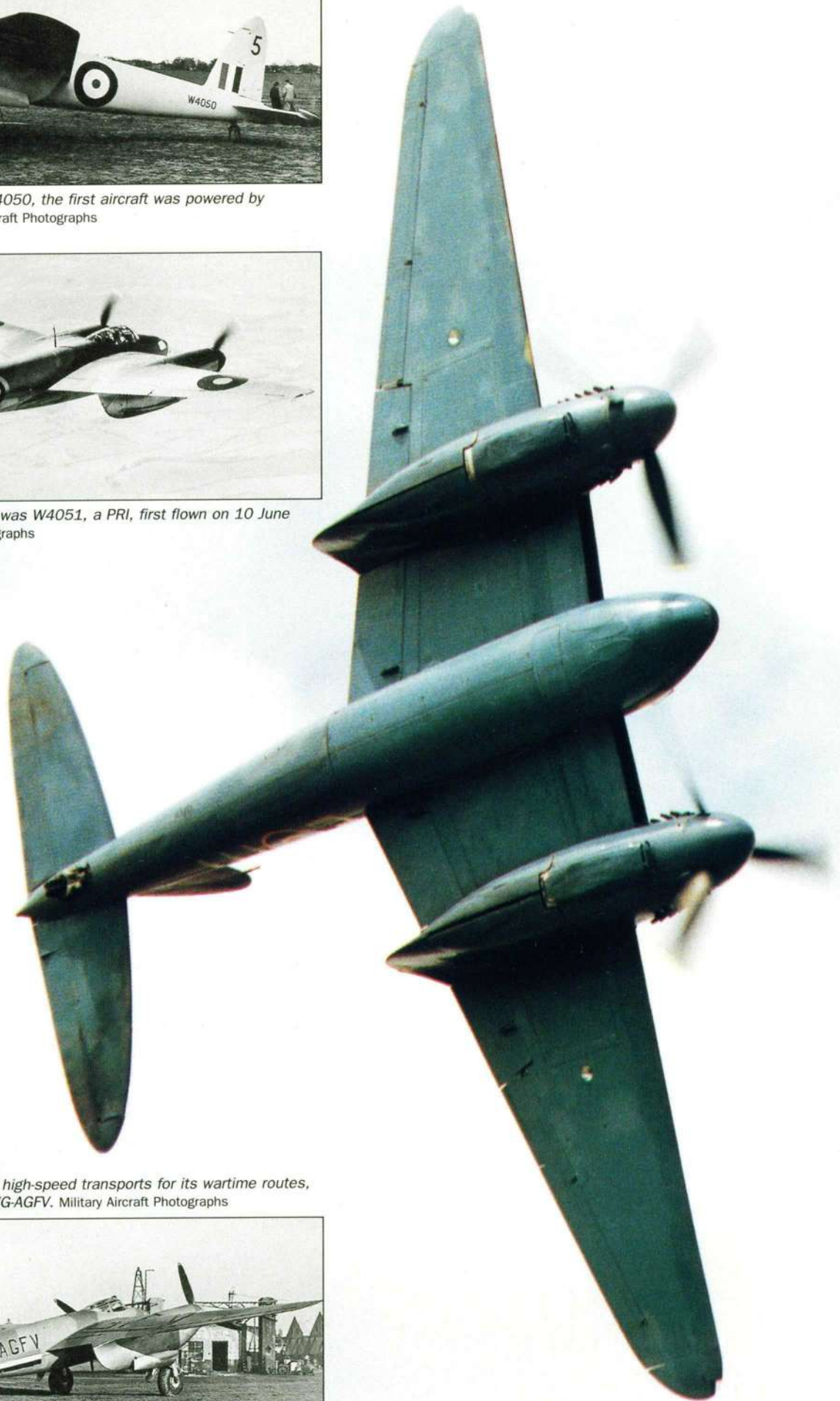




Subsequently serialled W4050, the first aircraft was powered by RR Merlin 21s. Military Aircraft Photographs



First production Mosquito was W4051, a PRI, first flown on 10 June 1941. Military Aircraft Photographs

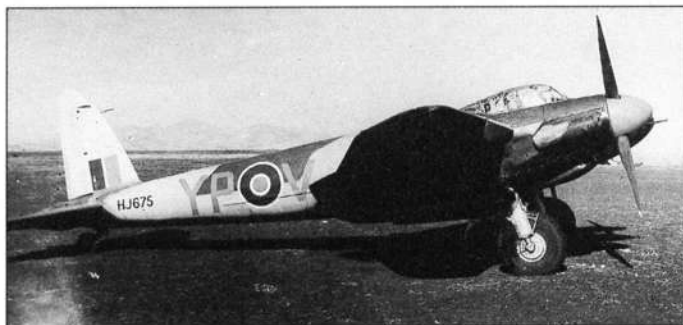


BOAC used Mosquitos as high-speed transports for its wartime routes, including this BIV DZ411/G-AGFV. Military Aircraft Photographs





Mosquito NFXIII HK428, a night-fighter, flown by No 29 Squadron.



Most numerous mark was the FBVI which was a multi-role variant.

in its primary roles. At Benson No 540 Squadron had drawn together all the Mosquito PR Flights in Bomber Command. The Marham Wing comprising Nos 105 and 139 Squadrons was fully operational on BIVs, and No 109 Squadron at Wyton was re-equipping to develop the Mosquito in the Pathfinder role whilst Fighter Command had five operational squadrons in the UK, having released No 23 Squadron to Malta to intrude over Italy.

Now that Mosquito production was flowing and squadrons growing it was time to look to developments. For its night-fighting role the Mosquito needed radar, so out went the four nose 0.303s and in their place went a centimetric radar, the result being dubbed the NFXII. This development was well timed as the Luftwaffe was now using Fw 190s and Me 410s for night nuisance raids and only an aircraft with radar and the speed of the Mosquito had any chance of dealing with them. Another night-fighter development was the NFXV; only four were built, being modified from a bomber version, the BXV, equipped with pressure cabin, extended wings and Rolls-Royce Merlin 61s with a two-speed supercharger. No 85 Squadron flew these aircraft against the high-altitude Junkers Ju 86Ps. By the time they were in service, however, the threat had largely passed so the aircraft were used at Farnborough for high-altitude research.

The next developmental step was the installation of the 1,680hp two-stage Merlin 72/73 engines, producing the PRIX and BIX

variants. These had greater range, greater ceiling and increased bomb load. The BIX came into Bomber Command as that organisation decided to use the Mosquito mainly for the Pathfinder Force. By now the demand for Mosquito variants was huge and production was initiated within the Empire, where the de Havilland companies had subsidiaries. In Canada one-seventh of the total production was contributed, the first aircraft flying in September 1942. All Canadian versions had mark numbers in the twenties and many of them served in the European, Mediterranean and Far Eastern areas. The Australian production took longer but with the smaller scope of the DH Australia Company, together with the fact that some components had to come all the way from England, meant that the company did not produce the first aircraft until December 1943. This was designated FB40 and was, in effect, an FBVI built in Australia. A total of 212 aircraft was produced there and served with the RAAF, mainly post-war.

The next step in the development process was to take the MkIX versions and refine them. A pressure cabin was built and fitted to a PRIX. This was re-designated PRXVI and very quickly this became the standard PR version for the rest of the war. At the same time the pressure cabin was fitted to a BIX and it was given a bulged bomb bay so that a 4,000lb bomb could be carried. This became the BXVI and the standard bomber version for the rest of the war. In effect, the MkIXs had been interim versions, leading on to the later standard aircraft. The bulged

bomb bay was carried across to the PRXVI enabling more fuel and cameras to be carried, giving it a very great range. This enabled the PR squadrons at Benson to range all over Europe at high-altitude; No 680 Squadron in Egypt, with detachments around the Mediterranean, covered the whole of southern Europe and No 684 Squadron in India (Calcutta) sent aircraft, with detachments, over the whole of the Far Eastern theatre.

In Bomber Command the IXs and XVIs spearheaded the Pathfinder Group and, within that Group, the Light Night Striking Force grew to eight squadrons, flying Canadian MkXX variants as well. Some of them specialised in marking small and difficult targets for the main force to bomb. Within Fighter Command the rapid development of new AI radars meant a whole succession of new Mosquito variants, each with a slightly better radar than the last. The Mosquito took over the whole of the night defence of the UK and also provided variants for the 2nd Tactical Air Force which went to France with the squadrons after D-Day. Three NF Mosquito squadrons went to the Mediterranean to provide typical Mosquito 'services' for the Italian campaign and different fighter variants, FBVIs amongst them, formed a significant part of the new No 100 Group in Bomber Command, formed to deceive and spoof the German defences; some squadrons were involved in ECM and 'spoofing' whilst others flew in the bomber streams and sought out the German night

This NFXV was a high-altitude night-fighter with extended wings and a pressure cabin.



fighters and attacked them, thereby getting them 'off the backs' of the bombers.

During 1944 the two-stage Merlins were fitted to the NF Mosquito, the result being designated NF30. This was timely because the V-1 offensive began in June and at night these were very difficult to find and track, despite the flame at the back. They were also fast, needing the finest AI and increased speed of the NF30. The Fighter Command Mosquito squadrons pitched in at night, the first victory going to No 605 Squadron on 15 June 1944. Nine Mosquito squadrons were committed and some were scoring an average of one V-1 per night. The task altered slightly when the V-1s were carried in on the backs of He 111s; the Mosquito crews endeavouring to catch the Heinkels as they came in ultra-low beneath radar coverage.

Meantime, the FBVI had become the epitome of the universal general purpose aircraft. It became an integral part of 2nd Tactical Air Force in fighter-bombing ahead of the advancing armies in France. It went out to do likewise during the final offensives in the Far East. Here there was a problem; due to the climate there was deterioration in the aircraft's structure, certain types of glue no longer holding the aircraft together. This resulted in a number of aircraft losing their wings in flight. So the Far East Mosquito units were grounded until all the aircraft had been inspected and those with suspect glue withdrawn. The offensive finally began in November 1944 with crews flying intruder bombing and strafing sorties by day and night and this continued right through until January 1946 because of the turbulent birth of Indonesia which required two squadrons (Nos 84 and 110) to take part in the anti-rebel operations there. Still later Mosquitos served with the reborn French Air Force in French Indo-China, bombing up until May 1947.

The FBVI made an entry into another RAF Command, part replacing and part supplementing the Beaufighter squadrons in Coastal Command. Here they also carried rockets on underwing racks in place of the bomb racks and found their metier in



Mosquito survivor, B35 RS709 is flown by Kermit Weeks in the USA. PRM

attacking enemy shipping along the Dutch, German and Scandinavian coastlines. Some were fitted with a 6lb anti-tank gun under the nose, firing slightly downwards, which packed a tremendous punch on anti-shiping strikes and particularly if a surfaced U-boat was found. This version was designated the FBXVIII and was distributed to some of the Coastal Command squadrons with some success. The Mosquito also featured in Operation 'Highball'. This was the code-name for a weapon similar to the dam-busting weapon of Barnes-Wallis. A new squadron, No 618, was formed to operate it, the aim being originally to sink the *Tirpitz*. Surplus Mosquito BIVs were used but by the time the weapon had been developed the *Tirpitz* problem had passed and No 618 moved out to Australia for operations against the Japanese battle fleets. It trained and waited at Narromine but the chance to operate never came and it was disbanded at the end of the war.

Another area in which the Mosquito operated was with British Overseas Airways. One of Britain's most valuable links during World War Two was with Sweden, for espionage and other purposes, as Sweden was trading with both sides. A small number of MkIVs and VIs were allotted to BOAC and were disarmed and fitted with a sort of cabin in the bomb bay, in close proximity to the long-range tanks. In January 1943 they began a service between Leuchars and Stockholm on these 'courier' tasks and a total of 520 flights was made.

As the war ended a new round of variants was just appearing, taking advantage of the new Merlin 113/114 engines. Of two PR variants, the PR34 replaced the XVI on the Benson squadrons, while in Bomber Command the B35 came into the only two squadrons left in an emaciated Command, these being Nos 109 and 139 at Coningsby. In Fighter Command the NF36 became the standard night-fighter both in the UK and in Egypt, serving until 1951. Coastal Command reduced its strike units to one squadron, No 36, at Thorney Island and this disbanded in 1947. By the early 1950s the Mosquito had all but passed out of operational service as the jet engine swept through the service. The Navy had briefly flirted with the Mosquito, Lt Cdr E M Brown of Farnborough had even flown one on and off a carrier, but little came of it.

The type had a war record second to none both in terms of accomplishment and of varied scope and its full contribution to the successful completion of the Air War will probably never be fully assessed. After the war its life was briefly extended as surplus airframes were sold to foreign countries to rebuild their peacetime air forces so that Mosquitos, mainly FBVIs, were to be seen in Swedish, Norwegian, Turkish, Belgian, Yugoslav, Chinese, Czech and Israeli markings, helping them to set a pattern for their re-emerging forces to build upon.

Such is the tremendous record of this world beater which started as a gleam in the eye of Sir Geoffrey de Havilland and flew for the first time fifty years ago.



Below: Ending service as a TT35, TJ138 is now being prepared as a B35 for display in the RAF Museum Roger Wright

Bottom: Surplus Mosquitos were sold worldwide after WW2 including this FBVI to Belgium. Military Aircraft Photographs





A No 19 Squadron Phantom taxis in with the imposing backdrop of the range mountains to the north. Lindsay Peacock

RED FLAG

Lindsay Peacock joins the RAF crews who visited Nevada last autumn to play the deadly game of 'Red Flag'

If it's gambling that you're looking for, Las Vegas is most definitely the place to be, for there is some very serious business going on here. In the luridly lit gaming palaces, amidst the ceaseless clamour of the slot machines, fortunes can quite literally be won or lost on the turn of a card, the spin of a roulette wheel or the toss of a dice. A few miles away from the hotels and casinos that jostle for space and custom along the celebrated 'Strip' one can find equally serious business, albeit of a rather different kind, as Vegas is also home to Nellis Air Force Base and Tactical Air Command's (TAC) Tactical Fighter Weapons Center. Known to generations of TAC personnel as the 'home of the fighter pilot', Nellis also serves as the host base for the continuing series of *Red Flag* exercises, with the 'battles' that are periodically fought out over the massive range complex that lies to the north being a key part of the process of bringing USAF aircrew to full combat-ready status.

Beginning life as a purely US Air Force exercise, *Red Flag* has steadily expanded its customer base since its inception in

the early 1970s and today it is quite commonplace to see rather unfamiliar types on the Nellis flight line and hear unfamiliar accents in the crew rooms of the *Red Flag* building. US Navy and Marine Corps personnel are usually invited to 'play' while Australia, France, Israel, South Korea and Thailand number amongst the steadily growing list of nations that have sent aircraft and crews to Nevada over the years.

So too has Great Britain, the Royal Air Force being one of the first overseas air arms to participate and barely a year now passes without some RAF personnel making the long trek west to avail themselves of the training opportunities offered by 'Flag' exercises. Buccaneers, Vulcans and Tornados have all cast their shadows across the desert floor during the past decade or so and the most recent exercise was particularly notable for its quite heavy RAF involvement. During *Red Flag 90-1*, which was held in October-November 1989, examples of the Jaguar, Phantom and Hercules all operated from Nellis itself, while Victor and VC10 tankers flew support missions

from March AFB, California.

Billed as the largest exercise of its kind to be held to date, *Red Flag 90-1* lasted four weeks within this period, being divided into two-week segments. Period One ran from 23 October to 4 November while Period Two took place during 6-18 November. Elements drawn from Strike Command and RAF Germany were present throughout, with a change-over occurring in mid-exercise so as to allow the benefits that accrue from *Red Flag* participation to be spread between several units.

Close to 150 fighters, bombers and transports were scheduled to take part with just over 100 operating Nellis itself. German and Italian Tornados shared ramp space with the British contingent alongside Singaporean F-16 Fighting Falcons, US Navy EA-6B Prowlers and USAF F-111s, F-15s, F-16s, RF-4Cs and FB-111s drawn from Alaskan Air Command and Strategic Air Command as well as TAC itself.

Although often denigrated as 'trash-haulers', airlift assets were not overlooked. Military Airlift Command C-

141B Starlifters were joined by Hercules from Great Britain, Italy and Singapore on daily visits to the range and there was also the inevitable Boeing E-3 Sentry for airborne command and control tasks in support of both 'Blue' and 'Red' force elements.

All of these types operated from Nellis itself, while the outlying airfield at Indian Springs hosted a smaller fleet of F-4E Phantoms from the USAF's 4th Tactical Fighter Wing (TFW) and F/A-18 Hornets from Marine Corps fighter-attack squadron VMFA-212. Other participants, which flew to and from the 'war zone' from their home bases, included B-1Bs of the 96th Bomb Wing at Dyess AFB, Texas and EF-111A Ravens of the 366th TFW at Mountain Home AFB, Idaho.

The RAF force that assembled at Nellis numbered some 20 aircraft, made up of eight Phantom FGR2s, ten Jaguar GR1As and two Hercules C1Ps. In addition, a couple of Victor K2s were present at March AFB during the first period, giving way to a brace of VC10 tankers at the exercise mid-point. The fighters were a varied assortment, being drawn from several units. As a result, the insignia of Nos 19, 56 and 92 Squadrons were all evident on the Phantoms while the Jaguars came from Nos 6 and 54 Squadrons. The Hercules were from the 'pool' of aircraft at Lyneham while the Victor and VC10 tanker support was provided by Nos 55 and 101 Squadrons at Marham and Brize Norton respectively.

As a logistical exercise, the task of moving these aircraft and supporting personnel and equipment across the Atlantic was quite demanding. Looking at the ten Jaguars, preparations for the deployment predated the move by some considerable time, it having been necessary to select aircraft that would not

require anything more than routine line servicing while at Nellis. Responsibility for the outbound ferry flight fell to No 54 Squadron and as the date for departure approached so the level of activity increased. As an aside, it was at one stage intended to apply a special 'desert-type' camouflage pattern to those aircraft earmarked for *Red Flag* but this plan was overtaken by time and the Jaguars which eventually flew west on 10 October retained the standard finish and unit insignia, as did the Phantoms with the solitary exception of No 56's handsome 'red-tailed bird'.

Tanker support for the trans-Atlantic sector to CFB Goose Bay was provided by a mix of VC10 K3s and Victor K2s with the Jaguar formation being split into pairs. Weather reconnaissance, command and control and, should it have been required, rescue back-up was courtesy of a Nimrod MR2 but the transit to Goose was completed more or less according to plan, apart from one pair of Jaguars which had to divert to Keflavik.

After a night-stop, the Jaguars continued on, flying via transit points in Canada and the USA to their eventual destination at Nellis, which they reached a few days before the exercise was due to start. Along the way, routine servicing was undertaken by pre-positioned RAF teams while an advance party was established at Nellis to await their arrival, together with a substantial amount of specialised support equipment for use by the sizeable RAF detachment. Having successfully negotiated the long haul from Coltishall, the ferry crews then enjoyed a short break before joining the rest of their colleagues, including some pilots from No 41 Squadron, who had travelled to Nevada in greater comfort aboard transport aircraft of Strike

Command.

After two weeks of action over the ranges, the mid-point change-over then occurred, with personnel from Nos 6 and 41 Squadrons plus No 226 Operational Conversion Unit travelling to Las Vegas by a VC10 which brought No 54 Squadron back.

Eventually, at the termination of *Red Flag*, the Jaguars were flown home to Coltishall by No 6 Squadron pilots, other members of the 500-strong RAF party returning on VC10s, TriStars and Hercules. Deployment of the Phantoms was accomplished in similar fashion although the point of departure and return was Wattisham. Exercise slots were divided between No 56 Squadron which flew the aircraft out and a mixed team from Nos 19 and 92 Squadrons which brought them home again.

As far as the *Red Flag* 'players' are concerned, there are a number of constraints and rules that have to be observed. For a start, pilots are required to have a minimum of 500 hours in command and navigators rated as 'combat-ready'. In addition, once the exercise gets under way, participants are required to 'work down' to the minimum permitted level of 100ft, with the first day being little more than a familiarisation sortie. Flown at 500ft AGL (above ground level), this is designed to allow the 'players' to acquaint themselves with the geography of the range area and air traffic control procedures. This caused some understandable frustration to the Jaguar pilots who had already satisfied OLF (operational low flying) requirements during the pre-deployment *Red Flag* work-up.

On the second day, the minimum level is reduced to 300ft, with the third and final drop — to 100ft — usually coming

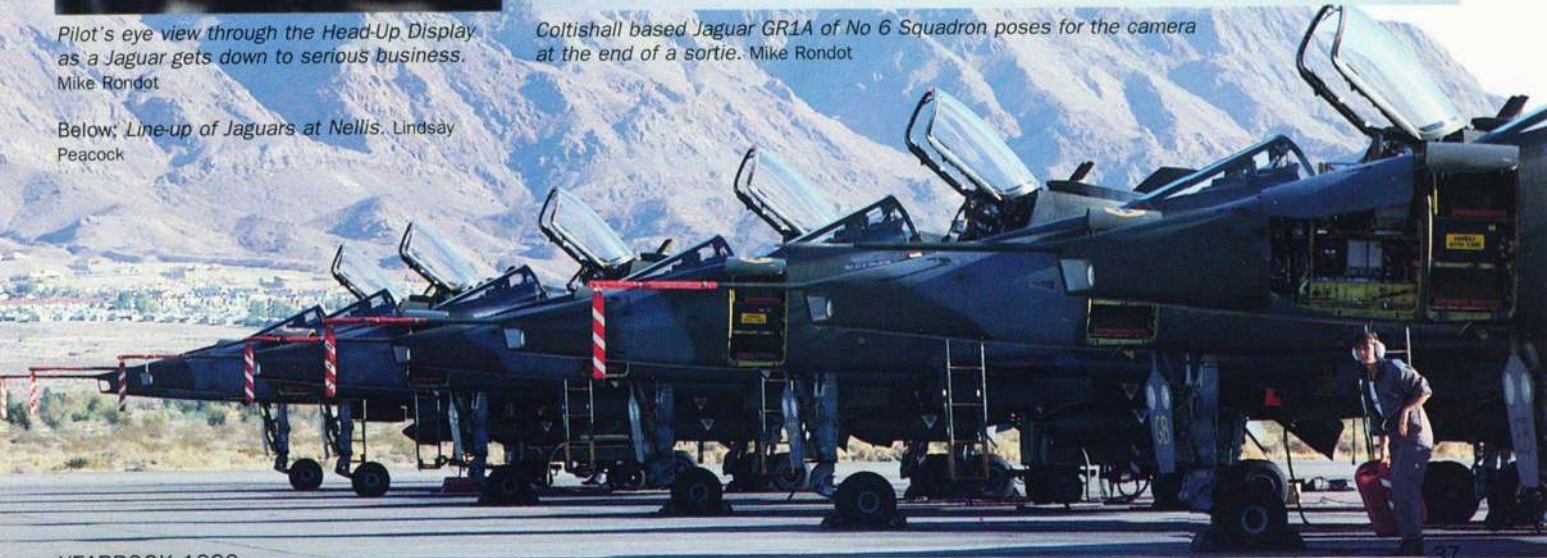


Pilot's eye view through the Head-Up Display as a Jaguar gets down to serious business.
Mike Rondot

Below: *Line-up of Jaguars at Nellis.* Lindsay Peacock



Coltishall based Jaguar GR1A of No 6 Squadron poses for the camera at the end of a sortie. Mike Rondot



on day three, although it may take longer to satisfy *Red Flag* planning staff who are almost obsessive when it comes to questions of safety. It must be said that they have good reason to be cautious since *Red Flag* has over the years suffered from a dismal catalogue of often fatal accidents, the very nature of the exercise being generally unforgiving of error.

While the chance to get down to low level at Nellis is valuable, it is in other areas that the principal benefits of *Red Flag* can be found. It is probably the nearest that pilots can get to a 'war situation' in peacetime and there can be little doubt that the area on the range which lies to the west of 'Student Gap' offers a formidable and taxing test of aircrew abilities.

Hazards abound, with the Nellis complex containing what is undeniably the most formidable concentration of threat simulation devices to be found in a single location. Surface-to-air missile (SAM) sites allow aircrew to obtain first-hand experience of what it is like to be 'locked-up' by missile guidance radars and also enables them to practice evasion tactics designed to escape.

Terrain-masking is one way of countering SAMs but the full bag of 'tricks' is employed, including electronic counter-measures, chaff and flares. In practice use of the latter was restricted so as to reduce the risk of scrub fires, the desert being by no means as devoid

period two, flying co-ordinated operations with the aggressor F-16s. For the second week, the Phantoms switched places and flew escort to 'Blue Force' strike elements.

The weapons used on *Red Flag* are for the most part inert but most 'Blue Force' participants get at least one opportunity to use live ordnance and Jaguars were to be seen with live and inert 1,000lb bombs as they headed out to do battle. For obvious reasons, fighters do not carry live weapons but they are equipped with inert rounds with active seeker heads so as to permit missile 'shots' to be called while the Phantoms also carried special pods similar to those of the Air Combat Manoeuvring Instrumentation (ACMI) system.

These pods allow data relating to flight path, altitude, attitude, speed and weaponry to be relayed back to the *Red Flag* Measurement and Debriefing System (RFMDS) computers for analysis and display in either 'real time' (ie as the action unfolds) or during post-mission debriefing sessions. Lacking compatibility with these sensor pods, the Jaguars were tracked by IFF (Identification Friend or Foe) transponder 'squawks'.

The Hercules can also derive much benefit from trips to the range. Mission profiles vary but can, for instance, be designed to simulate operations involving the 'landing' of special forces. As a result, low level flight is a matter of routine but they too are engaged by a

evasive action may well have negated the hazard from the ground, it presented the fighter with a 'fat target' which was eagerly accepted.

As far as benefits are concerned, the flying may, in some ways, be said to be almost incidental, with most observers and participants being firmly convinced that the greatest value of *Red Flag* lies in pre- and post-mission activities. In the former category are planning and briefing and the RAF is anxious to ensure that non-executive squadron personnel — typically young Flight Lieutenants — are given every opportunity to get involved.

One way of achieving this is by allocating a share of 'package commander' slots to personnel in this category. Since the 'package commander' is responsible for conceiving an attack plan and liaising with other elements, which may number 20 or more aircraft, it follows that this provides valuable experience of command as well as first-hand knowledge of the difficulties that can be encountered in managing sizeable formations in a realistic war scenario when the 'heat of battle' can and does get in the way of more rational thought.

A good example of this involved a Jaguar which had become separated from the rest of the formation and was in danger of being 'bounced' by 'Red Air'. Flying behind the Jaguar were some members of the Italian contingent and it was one of those who, alert to the danger, warned the Jaguar pilot to take evasive action. Unfortunately, in the excitement of the moment, he lapsed into his mother tongue and called the warning in Italian! Needless to say, it went unheeded...

Even greater benefits accrue from post-combat debriefing sessions, where lessons learned in those hectic minutes over the ranges are forcefully hammered home. Section and formation debriefings are conducted 'in-house' and inevitably focus on plus and minus points, often with the aid of printed copies of data from the RFMDS. Then it's off to the theatre, where, on the 'big screen', earlier activity is replayed for the benefit of all participants in a mass debrief which can easily last than the mission itself and which enables every aspect to be examined and analysed in close detail.

As far as conclusions about *Red Flag* are concerned, it has perhaps fallen victim to its own success in that many people perceive it as being the ultimate test of a pilot's ability. Although this is not the case, there can be little doubt that exposure to the hazards of *Red Flag* will stand pilots in good stead should they ever be called upon to deliver weapons in anger, for it should never be forgotten that the RAF trains as it would intend to fight. Participation in *Red Flag* offers the opportunity to put some of that training to the test in what is still the most realistic way possible short of actually going to war. In doing so, it also gives valuable lessons to all — 'new brooms' and 'old sweats' alike — and it is for that reason that opportunities to 'play the game' at Las Vegas are seldom wasted.



An 'enemy' F-16 Fighting Falcon from the locally based 'aggressor' squadron. Lindsay Peacock

of flora as most people would expect. Added realism is offered by a device known as 'Smoky SAM'. This cardboard and polystyrene 'weapon' is fired skywards to simulate hand-launched missiles. It appears most realistic and probably results in the occasional 'heart-stopping' moment, even though it is totally harmless.

Threats from the sky are not overlooked. Strike aircraft intent on penetrating to their designated targets must run the gauntlet posed by 'Red Air' fighter aircraft, which fly combat air patrols along the anticipated line of advance. F-16 Fighting Falcons from the locally-based 'aggressor' squadron simulate Soviet tactics in attempting to 'take-out' the strike forces as they ingress and they are invariably assisted by F-15 Eagles. The RAF Phantoms also joined the 'enemy' for the first week of

variety of threats as they move through the 'war zone'. ECM pods help to minimise the danger from the ground but counter-air tactics are also practised since fighters obviously pose an equally serious threat. While the aircraft that they fly might not be quite as agile as that of an opponent, crew co-ordination in concert with well-timed manoeuvres can make all the difference when it comes to a duel over the ranges.

The RAF Detachment commander Group Captain Moore revealed that the presence of multiple air and ground threats tends to make life very difficult for the humble 'Herky-Bird'. Indeed, on a C-130 sortie with a No 47 Squadron crew, which he accompanied, the aircraft in which he was flying was adjudged destroyed when engaged by a fighter while trying to evade a ground threat. In such circumstances, the options are limited and while the

32 SQN

The RAF's mini-airline



T Malcolm English reviews the history and current operations of No 32 Squadron

No 32 Squadron was formed on 12 January 1916 at Netheravon, from a caucus of No 21 Squadron, with Henri Farman training aircraft and Vickers FB5 Gunbus fighters. Since then the squadron has been based in three continents, has operated some 30 different types and marks of aircraft and has flown in practically every role of air power.

Only four months after its formation, No 32 Squadron moved to France where it was equipped with DH2 fighters for offensive patrols and interdiction. On 1 July 1916, at the start of the first Somme offensive the CO, Major L W B Rees, attacked a ten-strong enemy formation. Despite a serious leg wound he damaged three enemy aircraft and routed the rest, an exploit which earned him the Victoria Cross.

No 32 Squadron was subsequently equipped with the DH5 which, although originally designed as a fighter, was relegated to the ground attack role. In 1918 the squadron returned to England to be disbanded. It reformed at Kenley on 1 April 1923 with the Sopwith Snipe and flew a succession of biplane fighters until re-equipping with Hurricanes in October 1938. The transition from biplane to monoplane was not without incident, five Hurricanes being written-off in accidents during the next ten months.

When WWII broke out No 32 Squadron flew its Hurricanes on defensive patrols from its Biggin Hill base returning, after a short period in France, to cover the evacuation from Dunkirk. During the opening weeks of the Battle of Britain No 32 Squadron was in the thick of the fighting, one of its Polish pilots being shot down twice in one day! Between June and August 1940 No 32 Squadron claimed 49 enemy aircraft destroyed and 25 probables. The cost was 22 Hurricanes destroyed and 14 damaged with two pilots killed and nine wounded. After a brief rest in northern England No 32 Squadron returned south, in December 1940 to fly convoy patrol missions. The following July the squadron was tasked with flying intruder missions, for which it was equipped with Hurricane Mk IICs.

Two years later No 32 Squadron moved to Algeria, where it provided protection for allied shipping. During 1943 the squadron covered to Spitfires and deployed for a short period to Italy. It returned to North Africa until 1 January 1944 when the squadron again moved to Italy, where it became part of the Balkan Air Force tasked with operations over Yugoslavia, Albania and Greece.

In February 1945 No 32 Squadron was transferred to Palestine, for internal security

duties, where it remained until May 1948 when it moved to Cyprus. The following year No 32 Squadron converted to DH Vampires, becoming the first jet-equipped squadron in the Middle East Air Force. In January 1951 the squadron re-equipped with DH Venoms and returned to Egypt for nine months before being transferred to Malta.

Other moves followed to Jordan and back again to Cyprus, after which the squadron returned to Britain for conversion to the Canberra. In March 1957 No 32 Squadron flew to Akrotiri, Cyprus, where it operated as a light bomber force until its disbandment on 3 February 1959. Coincidentally the Metropolitan Communications Squadron at Northolt was reorganised and reformed as the new No 32 Squadron.

Tasked, as the unit's previous name implies, with communications duties, No 32 Squadron inherited a varied fleet of fixed and rotary wing aircraft comprising Pembroke, Bassets, Sycamores and an Andover. The Pembroke were withdrawn in 1969 to be replaced initially by Whirlwind helicopters and later by Andovers. The Whirlwinds also served to replace the Sycamores, which were phased out of service in 1972.

In 1971 No 32 Squadron received the first of its BAe 125 Series 400 executive

Top: The BAe 125 CC3 has a range up to 2,000 miles and operates worldwide. Graham Finch



Main photo: Wg Cdr J R D Morley CBE, OC No 32 Sqn, at the controls of a Gazelle HT3 over RAF Northolt. T Malcolm English



Top: SE5As were flown by the squadron at the end of WW1. PRM
Above: Hurricanes equipped No 32 Squadron from October 1938 until replaced by Spitfires in April 1943. PRM

Top: Bristol Sycamore HC14s were handed on from the MCS in February and flown from Northolt until August 1972. PRM
Above: This unique Whirlwind HCC12 was used for VIP flights after it was retired from the Queen's Flight. PRM

jets. These were supplemented by two BAe 125 Series 600s in 1973 and BAe 125 Series 700s in 1983. The Bassets were withdrawn from service in 1975 and the aged Whirlwinds retired in 1981. The squadron's rotary wing tasks were taken over the following year by Gazelle light helicopters.

The role of No 32 Squadron has changed little since its formation in 1969, its customers now including members of the Royal Family, Government ministers, foreign dignitaries, NATO officers and RAF personnel. Although the squadron regularly provides a VIP service, it is also often tasked to convey other non-VIP passengers. Tasking of No 32 Squadron is via Headquarters No 1 Group at Upavon.

The squadron consists of three operational flights, each with a different type of aircraft for their dedicated roles and a training flight responsible for conversion training on BAe 125 and Andover aircraft.

A Flight is equipped with Andover CC2s; B Flight with Gazelle HT3s; C Flight operates three marks of the BAe 125 and Training Flight is allocated BAe 125 and Andover aircraft from the operational pool.

A Flight operate the largest aircraft of No 32 Squadron, its four Andover CC2s having seating accommodation for 18-28 or 30-44, depending on the status of the passengers and details of the task. The Andover CC2 is the military version of the civil HS 748 Series 2 and differs from the other variants in RAF service, the C1 and E3, in being equipped purely for passenger carrying duties.

There are 22 personnel in A Flight, including five captains, two co-pilots, two stewards and a stewardess. The Andover has a normal crew complement of two pilots, a navigator, an air-loadmaster and a steward/ess. Its primary role in the squadron is that of conveying the larger parties to destinations in the UK,

Scandinavia and Europe.

At the time of our visit, in October 1989, one of the Andovers was touring the RAF(G) bases with a party of MPs, members of the House of Commons Defence Committee, who were carrying out an investigation into low-flying in Germany. Earlier in the year, A Flight transported a team of eight Directing Staff Officers of the RAF Staff College, Bracknell, on the 3,000 mile flight to Moscow for a visit to their opposite numbers at the Yuri Gagarin Academy.

The Gazelles of B Flight operate at the opposite end of the endurance/range/payload scale and are, accordingly, tasked with short distance flights of small parties. B Flight is also the smallest unit within No 32 Squadron, comprising four Gazelle HT3s and three pilots from which the flight produces two aircraft per day. The aircraft include both the first (XW852) and last (ZB629) Gazelles to be bought by the RAF.

B Flight normally operates in the London area, the Gazelles carrying three passengers and a pilot. Four passengers can be carried, with three on the backseat, but it is a bit of a squeeze. Until recently, a navigator was carried as part of the standard crew, which limited the maximum number of passengers to three. However, the increased space gained by the elimination of the navigator has been negated in part by the addition of flotation gear; the weight of which reduces the payload.

Flotation gear was fitted to the Gazelles during 1988 for increased safety. As mentioned, many of B Flight's sorties are in the London area, where the route could take them along the Thames. Most of B Flight's tasking takes advantage of the

Light communications Beagle Basset CC1s were operated widely for six years up to 1975. PRM





Andover CC2 of A Flight, in front of one of the Northolt hangars. T Malcolm English



Night flight; an Andover CC2 of No 32 Squadron, A Flight, taxiing for a night sortie from Northolt. T Malcolm English

Gazelle's ability to operate from small sites and relatively high speed and low operating cost in and around the capital, in particular its ability to fly passengers from inner London to an outlying station at 120 kts. For journeys of around one-hour's flying time from the centre of London, it is quicker than the alternative; car, fixed-wing aircraft and then car.

In addition to these local flights, the Gazelles have operated as far afield as Barrow, in the north west of England, to Leeming, in the north east, Plymouth in the south west and Dover in the south.

C Flight is the largest of the three No 32 Squadron flights, having twelve BAe 125s, comprising: four BAe 125 CC1s (civil series 400B), two BAe 125 CC2s (civil series 600B) and six BAe 125 CC3s (civil series 700B). It has 15 captains, eight co-pilots, five stewards and five stewardesses.

Although now somewhat old in the tooth, by executive jet standards, the BAe 125s retain the type's original selling features; in particular the high cabin, which allows passengers to stand upright. All of the aircraft are powered by Garrett AiResearch turbofans, the BAe 125 CC1s and CC2s having been re-engined. This gives a much improved performance and must have been welcomed by the local inhabitants of Northolt as it only generates as much noise on take-off as the earlier Viper engine when taxiing!

Outwardly, the BAe 125 CC1 can be identified from the CC2 and CC3 in having a shorter fuselage and five cabin windows per side compared with the others' six. Internally the BAe 125 CC1 can carry a maximum of five passengers although



One of No 32 Squadron's BAe 125 Series 400 aircraft on a north-side apron at RAF Northolt. T Malcolm English

ideally, for comfort and to allow a reasonable baggage allowance, it carries four. The BAe 125 CC2 and CC3 can carry up to seven passengers, together with a limited amount of baggage. All of the BAe 125 series have a normal crew compliment of two pilots and a steward/ess.

The BAe 125 is No 32 Squadron's highest performance aircraft with a range of 1,800 to 2,000 miles and typical cruising speed of Mach 0.74 at between FL 350 to FL 370 (35,000 ft to 37,000 ft). C Flight's theatre of operations includes the United States, Africa and as far east as Katmandu. At the time of our visit, an aircraft of C Flight was in the Middle East and one was due to fly to India.

Flight Commander Training is responsible for both the OCU's (Operational Conversion Units) run by the squadron to train BAe 125 and Andover aircrew on type. Although the RAF have a number of BAe 125 Dominie T1s in service and the Andover is also operated in the Flight Checking role, there is sufficient difference between the types and roles to justify the dedicated OCU's at Northolt.

The Gazelle pilots are all flying instructors from No 2 FTS, Shawbury and do not come within the Flight Commander Training's province. Training Flight comprises the Flight Commander and four pilot instructors. Navigation, Air Loadmaster and Steward training remains the responsibility of Flight

Commander Training, but draws instructors from the body of A Flight when needed.

As befits the squadron's role, aircrew selection is dependent not only on flying skills but also the ability to work in a VIP environment. Although an obvious requirement for cabin crew, it is of equal importance for B Flight pilots who literally work extremely closely to their passengers and for the BAe 125 pilots who frequently are the sole representatives of their Service when operating at extended range, overseas.

In line with the current Ministry of Defence policy to submit non-operational tasks for tender, first and second-line servicing of No 32 Squadron aircraft is carried out by Field Aircraft Services. Third-line servicing of the squadron's BAe 125s is carried out by British Aerospace at Hatfield, the Gazelles are serviced by Marshall of Cambridge Outstations Ltd at Shawbury and the Andovers by Lovaux at Bournemouth Airport. Similarly, in-flight catering is provided by a civilian contracting company.

No 32 Squadron aircraft perform some 9,000 movements per each year. Over the past twelve months, A Flight has flown 900 sorties, carrying 5,424 passengers a total of 1,160,000 miles; B Flight has flown 500 sorties, carrying 532 passengers a total of 61,500 miles and C Flight has flown 3,300 sorties, carrying 6,540 passengers over 1,261,000 miles.

No 32 Squadron's location at Northolt is a mixed blessing. Although the unit is situated within 15 miles (as the Gazelle flies) to the centre of London and half of that distance to Heathrow, it also lies within the London Control Zone and is thus restricted in its operating procedures. All



Crew and passengers disembarking from one of the BAe 125 Series 400 aircraft on the south-side apron at RAF Northolt. T Malcolm English

movements require prior permission from the Special Visual Flight Rules Office at Heathrow and all inbound flights are under the direct control of Heathrow Air Traffic Control.

As circuits are forbidden, a missed approach requires the aircraft to hold to the north for permission to reposition for another straight-in approach. Fixed-wing departures to airways usually receive clearance to join the airway over a beacon, in accordance with their flight plan. The Gazelles of B Flight have permission to use pre-determined helicopter routes within the London Control Zone.

Without wishing to denigrate the

professionalism of commercial executive operators, No 32 Squadron provides a service second to none, both in terms of punctuality and security. Timing is of the essence for many of the squadron's tasks and great pride is taken in being able to make 'doors (arrival) time' within seconds of that planned. Understandably, little can be said about security, other than full measures are taken to ensure the safety of all passengers both during embarkation and in-flight. Similarly, details of No 32 Squadron's role in wartime are classified, but it will doubtless include continuing the essential task of providing a communications facility.

FOR HIGH PERFORMANCE



VICKERS WELLESLEYS
AIRMEN PREFER SHELL

JAMES GARDNER

...and they still do.

This illustration is taken from a poster displayed on Shell lorries before the outbreak of the Second World War, in 1939.



Shell Aviation Service

BOMBER COMMAND HALL

HENDON

ROYAL AIR FORCE MUSEUM

Richard Simpson, Keeper of Aircraft and Exhibits

Opened in 1983 the Bomber Command Hall is dedicated to the memory of the 55,000 Royal Air Force and 76,000 American aircrew who were killed during the bombing offensive against Germany and her European allies. The story is however wider than just World War 2. The displays cover the development of aerial bombing from the earliest machines right up to the most recent times.

As you enter the Hall you see the imposing Lancaster I R5868 immediately in front of you. This aircraft served with Nos 83 and 467 Squadrons and recorded at least 137 operational sorties, although it may well have flown several more. It is perhaps remarkable that this aircraft flew over 800 operational hours during its career. As the German defences increased in efficiency Bomber Command losses grew and it was by no means uncommon for Lancasters to record much less than a tenth of this operational flying time before their loss. With such an impressive war record it

was natural that this aircraft should form part of the original RAF Museum opening display in 1972. When the Bomber Command Hall was added it was moved to become the centrepiece.

To the left we can see the Lancaster's daylight counterpart, the Boeing B-17G. This Flying Fortress was built by the Douglas Aircraft Company and delivered to the United States Navy in July 1945. After several years of service it was placed in storage in 1955 and a year later it was sold. Converted to a fire fighting bomber, it was acquired by the United States Air Force, re-converted to bomber configuration and presented to the Museum in 1983.

Positioned immediately in front of the B-17G is one of the newest aircraft exhibits in the Museum's collection. The P-51D Mustang was one of the outstanding American fighters of WW2 and the RAF Museum has been searching for a suitable example since the early seventies. An exchange deal was arranged with the

Lancaster I R5868 took part in 137 bombing raids in WW2. PRM





American Eagle Squadron Association of San Diego whereby they received a Spitfire in exchange for this particular example. After a considerable amount of remedial work and a complete repaint by RAF Halton this fine example can take its rightful place close to the bomber it did so much to defend. The aircraft is painted in the markings of a New Zealand pilot who flew with the 357th Fighter Group, 363rd Fighter Squadron, Eighth Air Force, USAAF.

As you move past the uniform and equipment displays you next come to the North American Mitchell. This B-25J was built in 1944 for the United States Army Air Force and is painted in American markings. Little is known about its service life but it appeared in two films - 'Catch 22' and 'Hanover Street'. It is hoped that one day it might be possible to repaint it in No 2 Group RAF markings.

The RAF Museum has always believed it impossible to tell the story of any campaign without dealing with those who fought with the RAF and those who fought against it. The next two aircraft exhibits reflect this view.

The Heinkel He 162 and the Focke Wulf Fw 190 were moved to Hendon from RAF St Athan in 1989 as the Ministry of Defence rationalised its historic aircraft collection display sites. The He 162 was captured at

Above: Sopwith Tabloid Replica representing a WW1 bomber and behind, the Vulcan B2 which was in action in the Falklands conflict.

Bottom: Recovered from Lake Hoklingen in Norway the Halifax II was shot down while attacking the Tirpitz on 27 April 1942. PRM

Below: The famous Vickers Vimy, an impressive biplane bomber which was just too late to see active service in WW1. PRM





Above: A B-17G Fortress operated by the 8th Air Force on daylight bombing attacks. PRM

Above left: Mitchells were flown by RAF and 8th Air Force squadrons. PRM



Left: Symbolic entrance to the Bomber Command Hall, with the Lancaster framed starkly in the pathway. PRM

Below: The Vickers Wellington, an early WW2 bomber famous for its geodetic construction. PRM



Leck at the end of the war and was brought back to Great Britain for evaluation. It flew a total of 26 sorties totalling 11hr 45min. The Fw 190 is an example of the rare field modified two-seat trainer version.

One of the Museum's most prized aircraft is next as we continue our tour. The DH9A is the sole surviving example of its type and served operationally with No 110 (Hyderabad) Squadron. On 5 October 1918 it was forced down behind enemy lines during a bombing raid. After the war it was placed on display in the Berlin War Museum and remained there until the early 1940s when it was damaged by RAF bombing. It was moved to Krakow in Poland for safe keeping where it remained until 're-discovered' in the 1960s. The RAF Museum began discussions with the Polish authorities in the early 1970s and although these negotiations dragged on, the Museum staff were determined not to give

up. In 1977 their efforts were rewarded when the talks were successfully concluded and the RAF sent a convoy into Poland to recover the airframe. The remains were taken to Cardington where the Museum's craftsmen built a complete set of wings, the tailplane and elevators and completely rebuilt the rest of the aircraft. The result is a fine example of the detailed restoration work undertaken in the Museum's workshops.

The DH9A stands beneath the wing of a Vulcan. This is a B2 variant which first flew in 1961 with No 617 Squadron. Over the next twenty years it operated with various units but by 1981 it was back with its first unit. No 617 Squadron flew its last Vulcan sortie in this aircraft on 11 December 1981. The walkway is arranged so that visitors can see into the huge bomb bay.

If the Vulcan leapt into the news at the end of its career the next aircraft came to

the attention of the general public from its earliest operations. The Mosquito was known as the *Wooden Wonder* because of its construction and was the epitome of the multi-role aircraft. Used as a bomber, fighter, photographic reconnaissance, trainer or shipping strike aircraft the type is presently represented by a T3 trainer but this is to be replaced by a B35 in the winter of 1990-91.

Another recent addition sits next to the Mosquito. This Spitfire PR19 was for many years on the gate at RAF Benson and is here to represent the Royal Air Force photographic reconnaissance units and squadrons which provided so much of the data required by Bomber Command.

The Sopwith Tabloid displayed is a replica built and flown by Don Cashmore before it was added to the Museum's collection. Rebuilt and re-engined after an accident in 1982, it now represents one of the earliest



Top: This Spitfire PR19 represents the important contribution made by photographic reconnaissance aircraft in WW2. PRM. Above: Representing the enemy fighters, this Focke-Wulf FW190 amongst the bombers in the Bomber Command Hall. PRM

British strategic bombing successes scored by Flt Lt Marix when he bombed the German airship sheds at Düsseldorf on 8 October 1914 and destroyed the LZ25 Zeppelin inside.

In its search for examples of famous aircraft types the RAF Museum has scoured the world. Halifax II W1048 testifies to these efforts. This particular example was built by English Electric in 1942 and was first allocated to No 102 Squadron. Transferred to No 35 Squadron in April 1942, W1048 took off on the 27th of that month on its first, and as it turned out, last, operational mission. The target was the German battleship *Tirpitz* which was lying in Foettenfjord near Trondheim in Norway.

W1048's four mines were dropped as briefed but it was almost immediately hit by heavy flak. Damage was so severe that there was no hope of returning to the United Kingdom, so a successful wheels-up landing was made on the nearby frozen Lake Hoklingen. The aircraft soon sank through the ice to remain on the lake bottom for the next 30 years. In 1973 RAF divers, aided by civilians, raised the aircraft and towed it ashore. The Halifax is displayed as she appeared when first beached.

Vickers Valiant XD818 is the only example of this first V-bomber now in existence. The aircraft served with No 49 Squadron from September 1956 until withdrawn from service nine years later. The unit was engaged in early British atomic bomb tests and on 15 May 1957 dropped the first British H-bomb at Christmas Island.

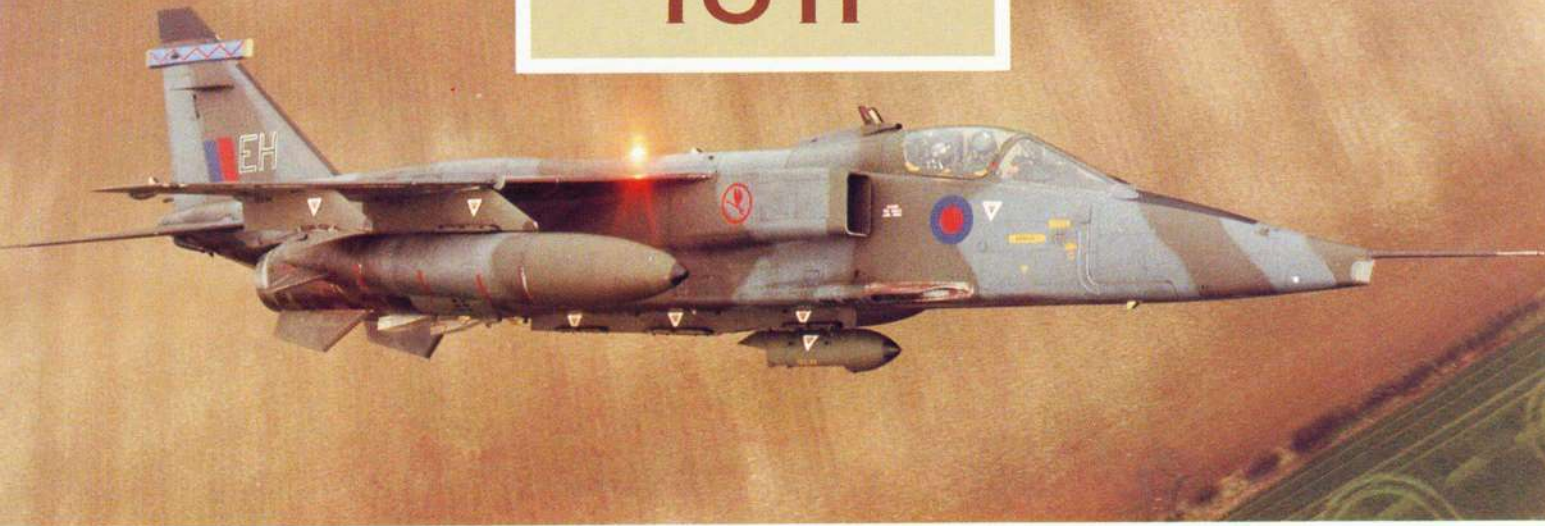
As one moves through the displays

depicting the work of Sir Barnes Wallis the next aircraft displayed is the Vickers Vimy. This 1917 design was in fact built by the Vintage Aircraft and Flying Association in 1967-69. The aircraft was flown in 1969 to mark the 50th anniversary of the Alcock and Brown Atlantic Crossing. It was badly damaged by fire on 16 July and was re-built to static display standard before being donated to the RAF Museum. It was moved from the main hall to its present location so it could illustrate the inter war heavy bomber.

The final aircraft in our display in this part of the Museum is the Vickers Wellington T10. Originally delivered to Hendon without a front turret, this was re-fitted to depict it more accurately in its bomber configuration. Although this aircraft saw no war service it stands as a tribute not only to its designer and its unusual geodetic construction but also to Bomber Command's early war years when it learnt a number of hard lessons in its battles over Germany.

Before we close this particular chapter of the Hendon story I would like to mention another bomber type which has just been restored and positioned in the RAF Museum Main Hall. I refer to the Fairey Battle which has been re-built over a number of years by the Royal Air Force; first at Leeming and then at St Athan. The size of this single-engined bomber made it impossible to locate in the Bomber Command Hall but it stands as a silent memorial to all those who sacrificed their lives in a vain attempt to halt the German Blitzkrieg through the Low Countries in May 1940.

GETTING DOWN TO IT



Jaguar GR1As based at Coltishall and Lossiemouth fly many low-level training sorties. Sgt Rick Brewell

THE CASE FOR LOW FLYING

Wing Commander Andy White, until recently a low level attack pilot on a Jaguar squadron, explains why low flying is such an essential part of the Royal Air Force training programme

Each year approximately 150,000 low level training sorties are flown in the UK by the RAF. A typical sortie will cover some 500 miles and exposes thousands of people to its environmental impact. That only 5,500 complaints are made each year shows that the level of public dissatisfaction with RAF training is relatively small. However, no one can deny that aircraft are extremely noisy, provoking complaints from individuals, local authorities and environmental groups.

So is low flying really necessary? Is it increasing? Is it carried out safely? Do pilots try to minimise the disturbance caused? Can it be done elsewhere? This article attempts to answer all these points, and also outlines the MoD procedures for enforcing the rules and for investigating specific complaints about low flying aircraft.

NATO's policy of deterrence has maintained the peace in Europe for more than 40 years. Our aircraft have played a major part in this because they have the unique ability to respond at great speed over large distances. They can be focused on an aggressor's line of advance as it develops, be it on land, sea or air, to blunt and contain his attack; they can cut his lines of supply, causing his attack to wither and they can destroy his rear

mounting bases to stop him launching further attacks. But to do any of this they must run the gauntlet of the increasingly sophisticated fighter aircraft, anti-aircraft artillery (AAA) and surface to air missiles (SAMs) that an enemy would deploy in support of such an attack.

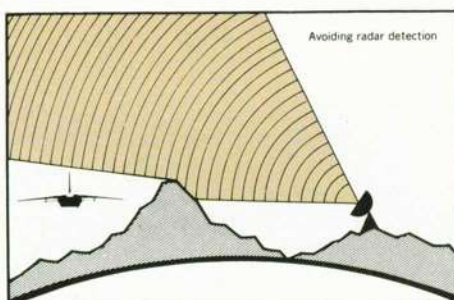
Such weapons have quite awesome killing power. For example, the ZSU 23/4 AAA, which is widely deployed by Warsaw Pact countries, can fire up to 3,400 rounds per minute out to an effective range of approximately 3,000m. The SA 10B, a typical modern Soviet mobile SAM, has a maximum speed of Mach 6.0 (more than 4,000mph) and can engage targets as low as 30 metres, even more important it can acquire, lock on to target and fire its missiles in a matter of tens of seconds as opposed to minutes. And the Soviets have a most impressive array of

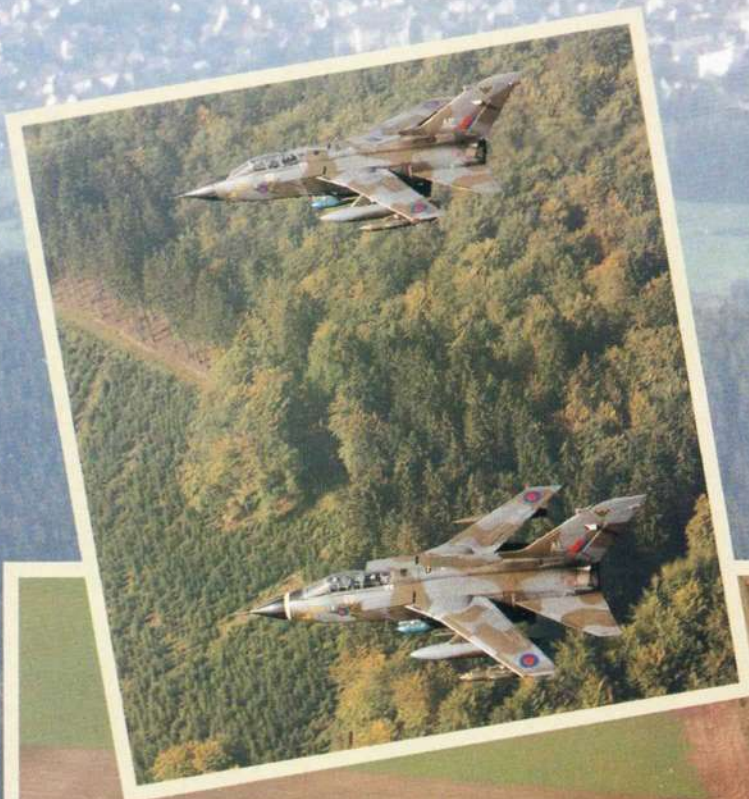
extremely effective agile fighters, such as the MiG29 *Fulcrum* or the Su27 *Flanker*.

There is only one way to survive against such weapons; and that is to fly as low and as fast as possible.

The technical reasons for low flying are quite straightforward. Radar, like the human eye, cannot see round corners. Both need 'line of sight' to acquire their target. For example, at 500ft and a speed of approximately 500 kt an aircraft can be acquired by a SAM radar when it is still 4min away. This gives the operator all the time he needs to 'lock' the target and to fire his missile or gun and let there not be any doubt that, once properly acquired, modern missile and gun systems rarely miss. However, this time is cut down to just one minute if the aircraft height is reduced to 100ft. If the aircraft travels at its maximum speed of up to 700kt and also takes advantage of the terrain to mask its flight path, dodging behind hills and making use of valleys, the warning time is cut to seconds. The operator on the ground has insufficient time and the aircraft survives.

When coupled with the added protection of electronic counter measures, such extremely low flying results in a degree of survivability and operational effectiveness that is unattainable by any other method of





Main picture and left: Tornado GR1s of No 9 Squadron on exercise over West Germany. Sgt Rick Brewell
Below: Low-level action from a Bruggen based Tornado GR1 of No 14 Squadron. Sgt Rick Brewell





Jaguar GR1A of No 6 Squadron in action. Mike Rondot



Harrier GR5 now in service with No 1 Sqn in the UK and No 3 Sqn in West Germany. BAe Above: Hawk T1A in air defence configuration. Sgt Rick Brewell



operation. But this means that, in war, aircrew must be able not only to fly their aircraft at a height of 100ft or less, but must also perform their combat mission under extreme operating conditions.

The RAF has developed highly effective modern aircraft, such as the Tornado, for this type of demanding mission. However, owning the hardware is only part of the equation. For without realistic training in the employment of these assets, the RAF would be wasting the serviceman's time and effort and more importantly the taxpayer's money. Low flying demands a degree of skill that can only be acquired through systematic training and constant, realistic practice.

The noise burden that would be imposed by continuous training at operational heights and speeds, less than 100 feet and approaching 700mph, would be intolerable. The support and understanding the RAF enjoys from the vast majority of British people would rapidly be eroded. Therefore, in peacetime there has to be a compromise between operational requirements and environmental and safety considerations. This is achieved by flying to the least intrusive parameters from which the RAF could go to war rapidly, a minimum height of 250ft and a maximum speed of 450kt.

The speed restriction of 450kt is imposed to reduce power settings and hence noise, but an occasional dash up to 550kt is allowed for intercept training and delivery of practice weapons at more realistic speeds. A normal minimum height of 250ft is imposed, although the bulk is carried out between 250ft and 600ft. In addition, every flight has to be individually authorised by an experienced supervising officer. He has the responsibility and duty to ensure that the sortie has been meticulously planned and is an essential part of the training programme.

Ninety-nine per cent of all low flying in the UK is carried out above 250ft. But in preparation for exercises in the remote parts of Canada and the USA, the remaining one per cent is carried out down to a minimum of 100ft. However, this flying is limited to three very remote parts of the UK.

In principle, the whole of the UK land area is open to low flying. This allows the noise burden to be spread as widely and as fairly as possible across the entire country and also provides the flexibility and variety of training essential for developing operational efficiency. Obviously there are areas where it is not sensible, nor indeed safe, for low flying operations so these areas are avoided. However, these protected locations are kept to the minimum since special consideration for one area would inevitably result in more low flying in another and hence a disproportionate share of the noise burden for some communities.

Simulators are used as far as possible to supplement low level flying training. However, although today's simulator technology is very sophisticated, it still cannot replicate the motion and rigours of low level flight. Equally, flying over a flat



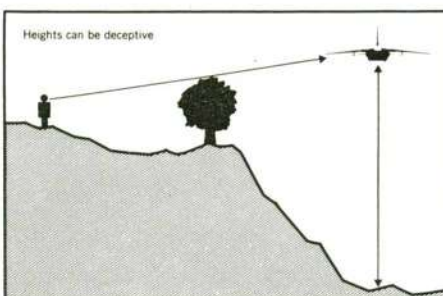
The Tucano T1 is progressively replacing Jet Provosts for low-level basic flying training. PRM

sea is of no operational training value for crews who will be called upon to operate over hilly and obstacle covered land. To be effective aircrew need to train within the environment that they might have to fight.

Most people accept the rationale for the need to train at low level. However, they may suspect that aircrew are tempted to break the rules and regulations because they see aircraft at what appears to them to be very close to the ground. In fact, experience shows that judging aircraft height from the ground is extremely difficult. For example, in height judging competitions held in 1987 at Battle of Britain Open Days, not only did most people underestimate heights, but more than 70 per cent of people were greater than 100ft out in their estimates; and 45 per cent were more than 150ft out. Next time you are at an air display, or RAF Station Open Day, pace out 250ft (85 paces) from a static display aircraft and take a good look—that's how close a low flying aircraft is to the ground or any object built on the ground.

To provide a further independent check that pilots are not breaking the rules, the RAF Police now deploy SKYGUARD radars in a height monitoring role. These radars, which were captured during the Falklands Conflict, are normally used to direct anti-aircraft guns. Thus, they are extremely accurate and well suited to this height finding role. The RAF Regiment radar operators, together with the RAF Police, regularly undertake covert deployments around the countryside to monitor low flying operations. All the evidence to date shows very clearly that RAF aircrew have a healthy regard for the rules.

There have, regrettably, been rare occasions when a specific complaint has provided reasonable grounds to believe that there may have been a breach of regulations. In these instances the matter is fully investigated by the RAF Provost Branch. A detailed report is produced which forms the basis for any further action, including informing the public of the outcome of the investigation and any



disciplinary action taken. On the few occasions it is needed, such disciplinary action is severe. The pilot is not simply 'carpeted' as many would believe, but would certainly face formal disciplinary action. He may even be prosecuted by Court Martial. In extreme cases he stands to lose a great deal of money as well as possibly his job.

Claims for compensation also arise from time to time and this is perhaps inevitable. But the MoD is anxious to ensure that no one suffers any loss as a result of military aircraft activity. The Department's Claims Branch has well established procedures for dealing with claims compensation, either from individuals or through farming unions and other groups. Providing it can be established that a reasonable link exists between the aircraft activity in question and the loss or damage complained of then the compensation will be paid.

There is, perhaps understandably, a tendency to think that more low flying equals more accidents. In fact this is not the case. Less than half of present day accidents involve aircraft which are low flying and in only a proportion of these is low flying itself the major contributory factor. The overall RAF accident rate has reduced steadily over the years and now stands at its lowest rate (in real terms) ever. This has been achieved as the proportion of RAF low flying has increased. A further significant statistic is that not one single civilian has been killed as a result of a low flying accident in this country during the past ten years.

As I mentioned at the beginning of this article, we fly approximately 150,000 low flying sorties each year. This is the minimum necessary to keep our front line pilots sufficiently trained to maintain their operational readiness. The total has been steady now for the past three years and is not expected to increase in the future. But in view of the dramatic changes that have swept through the Soviet Union and her allies, do we still need to maintain the capability to operate at low level?

For the foreseeable future the answer can only be yes. We must continue to base our readiness posture on actual capabilities, not on words alone. Intentions can change tomorrow. The forthcoming conventional arms talks will, hopefully, lead to a reduction in military hardware and an easing of tension. Hopefully the day will come when we achieve real and lasting peace. Until then, however, we must maintain our guard and that means a continuing commitment to train at low level.

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NOT ON MY BEACH



Among the astonishing suggestions in 1940 was one to equip Henlow's parachute testing Vickers Virginias with 37mm nose cannon for beach strafing.

Opposite top: *Blenheim IVs of No 40 Squadron at Wyton circa August 1940. These aircraft passed to No 114 Squadron in November 1940 after being actively engaged in summer operations.*

Michael J F Bowyer

Not for almost 900 years had an invader dared to step upon our shores and a repeat was barely contemplated by the British public, until the German army swarmed along the French coast in June 1940. The Government and the Services had also rated an invasion unlikely. Men, aircraft, guns, warships and the general needs of the war machine constructed in the 1930s provided sufficient drain upon national resources without diverting any to a very hypothetical affair.

Hostilities were but a few hours old when a U-Boat sank the British merchantman *Athenia*. Enemy warships, which had slipped unobserved through the Greenland Straits, were soon making themselves well known in the Atlantic. German Air Force bombers and seaplanes began monitoring British coastal shipping movements and in October Ju 88s struck at warships off Rosyth. Such events, along with the sinking of the battleship *Royal Oak* in Scapa Flow, unprotected by air cover, meant one thing; the Royal Navy did not control the North Sea. Its removal to safer, west coast anchorages made the east coast ripe for seaborne raiding parties and even major intrusions by German forces. Any such events would have undoubtedly caused widespread alarm among civilians while allowing infiltration by agents and saboteurs. 'Phoney' the start of the war may have seemed; strategically the early weeks delivered some nasty shocks.

How could landings be prevented? By drafting large numbers of second line troops into eastern coastal areas where, within long periods of boredom, they prepared to defend our shores. By extensive construction of coastal defences particularly around shallow estuaries and thirdly by posting Army

units to defend aerodromes. All were particularly expensive in manpower and devoured huge resources for what still seemed unlikely.

Since an enemy bridgehead would have been difficult to dislodge, it was vital that any invasion attempt be dealt with at sea, a task allocated jointly to Bomber Command and the Royal Navy using, in particular, its destroyers. Sinking ships by bombing was more difficult than might be imagined. Two Flights each of three Boulton and Paul Sidestrands of No 101 Squadron had, in 1933, been involved in intensive trials against HMS *Centurion* to discover the easiest method. The conclusion was that a formation of bombers at medium level releasing salvos of bombs offered the greatest likelihood of success. Even so, 103 salvos totalling 303 bombs were released and still the vessel survived. By 1939 it was obvious that much more sophisticated tactics and ample courage would be required for such ventures and even locating ships in wartime proved difficult.

Forces with which the RAF planned to prevent or harass any invasion were extremely varied. Under Western Plan WA12 the task of sinking enemy ships at sea was allocated to No 3 (Bomber) Group's Wellington squadrons and the Hampdens of No 5 (Bomber) Group. At the end of September 1939, when the first invasion threat was perceived, the two Groups began armed sweeps over the North Sea seeking enemy surface ships.

Throughout that first winter of war coastal defence building proceeded at only a moderate pace and North Sea sweeps proved fruitless. Unknown to the British, no landing in Britain was yet planned.

When the fighting broke out in France it

quickly caused a review of current Army/RAF activity. The RAF's Field Force was divided into two formations. One was the 1st Echelon, Advanced Air Striking Force, formed with nine squadrons of No 1 (Bomber) Group's Fairey Battles. The other was the Air Component supporting the British Expeditionary Force with four squadrons of Blenheim I/IVs available to meet the Army's strategic reconnaissance and bomber needs and five squadrons of Lysanders for tactical reconnaissance. Both types suffered badly during the May-June 1940 fighting, 56 Blenheims and 34 Lysanders being listed as missing during operational flying. Lysanders could escape from fighters, but not evade flak. The intention had been to provide Defiant turret fighters to give general protection but those aircraft, planned to have light bombing capability, were not ready in time. It was that which forced Dowding to part with squadrons of precious Hurricanes.

Held in reserve in Britain were Blenheim IVs of No 2 (Bomber) Group forming 2nd Echelon, AASF and instructed to delay enemy forces during any attack on France and by producing choke points and impeding progress. No 22 (Army Co-operation) Group, assisting the Army at home, was controlled by Fighter Command and operated more Lysanders backed by a handful of Hector biplanes placed in No 613 Squadron.

The Air Staff had agreed to maintain a minimum of 15 bomber squadrons, 250 aircraft and Lysander/Hector squadrons, to support the Army, none of these aircraft being particularly suited to the task. Needed was a fighter-bomber along the lines of the German Bf 109 operational in that role by August 1940, but whose tactical value had yet to be



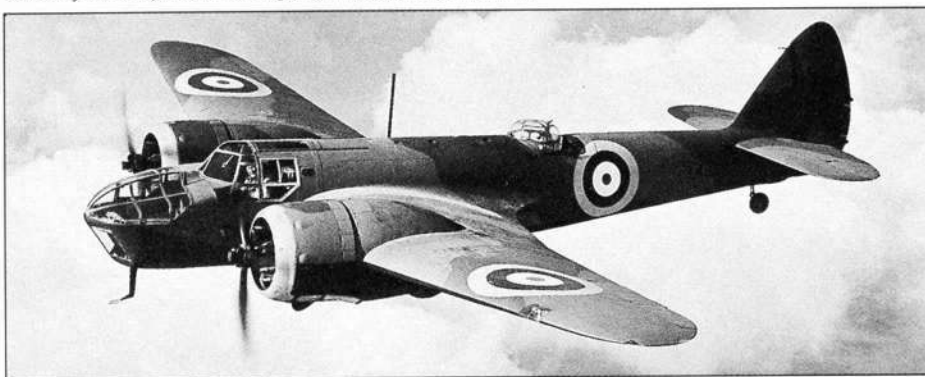
appreciated. Some RAF fighters had carried light bombs and general purpose aircraft like Wapitis, Gordons and Hart variants had used light bombs when tackling the Empire's dissidents. But in Europe messages snatched by hook and the means to quell outlaws were hardly applicable. Nevertheless, since it was the most numerous army co-operation aircraft, the Army had to depend upon a message hook equipped 'Lizzie', as easily recognisable by sight as by sound.

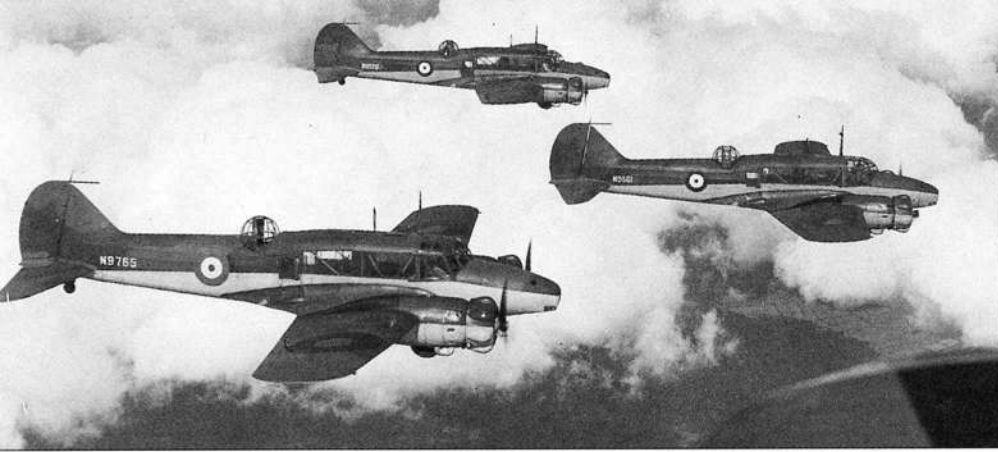
Nine Westland P8 Lysander squadrons theoretically holding 162 aircraft were operational during much of the Battle of Britain, making Lysanders the second most numerous anti-invasion aircraft. First flown on 15 June 1936, the two-man Westland A.39/34 Lysander was produced by a company which had recently passed through difficult times. Internally very noisy, the Mk I was powered by a Bristol Mercury, expectation being that the Mk II would have the more powerful Bristol Perseus XII. Instead, that engine's greater weight dashed such hopes. A heavily loaded 'Lizzie' could, with skill, be flown as slowly as about 42 mph ASI at which speed it entered a stall glide, wing slots having opened at about 90 mph. Performance of the Mk Is was little better than the Hawker Hector which they replaced. L4673 tested, at 5,833lb, reached its top speed of 220 mph at 10,000 feet which it reached in 5½ minutes. At sea level its top speed was only 206 mph and it stalled at 55 mph. Normal landing run was about 240 yards 480 yards from crossing a 50 foot obstacle, although skilled performers achieved astonishing short landings. To clear 50 feet it needed a take off run of about 250 yards. The pilot's view was excellent and once down any landing

Above: The distinctive Lysander equipped nine squadrons during the Battle of Britain.

Below: Blenheims formed the backbone of the anti-invasion reserve force.

Bottom: Troublesome engines delayed its effectiveness but Beaufort squadrons would almost certainly have operated during any invasion attempt. IWM





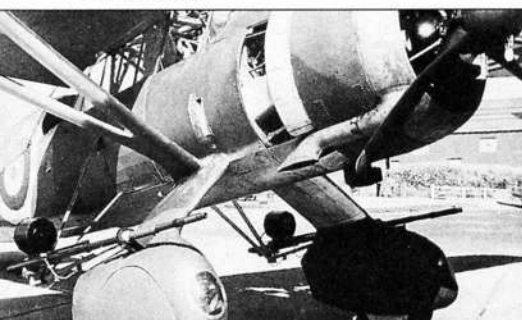
A trio of Ansons of No 9 SFTS, any of which might have been thrown into the fight as reinforcements. Ansons could carry bombs in inboard wing cells.

shocks were well absorbed by the huge spatted undercarriage from which stub wings protruded to carry light bombs. One of the seven studies from which the Lysander evolved had a retractable undercarriage, but handling on rough ground was better with fixed gear and not easy in winds of up to at least 30 mph. Maintenance was none too easy and mud congregated within the spats, but the biggest problem was the Lizzie's low speeds, a maximum around 200 mph and often less and a cruising speed of about 150 mph.

Once Norway fell an invasion from that quarter gained credence and remained feasible until 1943. Consequently, Lysanders were attached to Scottish-based Army formations and a couple of 2 Group Blenheim squadrons based at Lossiemouth daily scoured the North Sea seeking invasion forces. Coastal Command Ansons, Blenheims and Hudsons carried out square searches for the same reason, but along the east and south coasts as the French debacle evolved, reality of invasion loomed largest.

Lysander squadrons withdrawn from France were soon spread along the coast from Land's End to John O'Groats and attached to Army formations. From a major concentration, at Cambridge, squadrons and detached flights worked along the inland defence line stretching from The Wash to London. Each of eight Lysander squadrons was allocated 18 aircraft, 94 being serviceable on 11 July, a typical return for that period. Two Hispano 20mm cannon each strapped to a stub wing had been tested and although they reduced the Lysander's speed by 12 mph orders were given to supply half of the squadrons with them.

K6127, the Lysander prototype, was fitted with two 20mm Hispano cannon lashed to its spats and fuselage.



Intended for anti-tank purposes only ball ammunition was available and useless for the purpose.

Delivery of the more powerful Mercury XVa Lysander Mk III fitted with self sealing fuel tanks commenced in August 1940, but it was October before the new version was generally introduced. By then there were strong moves to reduce Lysander production and divert the engines to other types.

Battles and Blenheims had been decimated fighting for France, total losses in action judged as 115 and 178 respectively. No 1 Group based behind the main defence line took over four Battle squadrons (64 aircraft) and trained them in steep dive bombing attacks on land forces. Blenheims would have attacked as the enemy was about to land, but in response to several special Directives nine squadrons of No 2 Group meanwhile operated using cloud cover and sometimes flying quite deeply into Germany. They also attacked French and Dutch aerodromes before, on 4 July, Bomber Command ordered attacks on ports and self propelled or towed barges, two days after a No 2 Group Blenheim attacked the first sign of barge traffic, at Gorinchem in the Netherlands. Four squadrons of No 2 Group undertook night raids, the first on 17/18 July then, next day, 18 Blenheims bombed Boulogne making one of their largest day raids of the period. On 12/13 August Hampdens of No 49 Squadron made a low-level attack on the Dortmund-Ems Canal blocking it to barge traffic for ten days. Flight Lieutenant R A Learoyd made his run in at 150 feet through a route lined by AA guns, his courage being marked by the award of the Victoria Cross.

March 1940 had seen the formation of No 416 Flight, Lysander equipped, at Aldergrove, Northern Ireland and upgraded into No 231 Squadron on 1 July 1940 because of fears that the Germans might invade Ireland. There it provided reconnaissance back-up to Irish based Battles of Nos 88 and 226 Squadrons. No 98 Squadron's Battles moved to Iceland in August 1940 to thwart possible landings there.

Nos 53 and 59 Squadrons were on 4 July transferred from No 22 Group to Coastal Command for anti-invasion and reconnaissance patrols and to attack ports, oil installations and coastal airfields thus disturbing invasion

preparations. Their ultimate losses appear to have been higher than any other Battle of Britain squadrons.

Nos 12 and 142 rejuvenated Fairey Battle squadrons also joined Coastal Command with a special task, to sink Boulogne's E-Boats, tasked to destroy Royal Navy warships engaging an invasion fleet. Apparently the Germans learnt of the British intent and repeatedly blasted Eastchurch, lair of these Battles. Detling, also heavily battered, accommodated coastal patrolling Ansons of No 500 Squadron and No 53's Blenheims.

The RAF's main response to invasion was vested in Bomber Command which, on 30 June, ordered all bomber stations to maintain, from sunset 1 July, crews and aircraft at standby to attack seaborne invasion forces. Most squadrons had six aircraft ready, from sunset to stand down next day. Invasion likelihood increasing, revised plans of 15 July required each crew to standby two times a week, except when the nine night full moon period demanded most night operations.

Concern remained that a few enemy troops might land in darkness and establish bridgeheads ahead of the main force. To prevent that pairs of Lysanders began in late June, and within *Plan Banquet*, to patrol at dusk and dawn coastal beats. Next to Blenheims, Lysanders formed the largest anti-invasion force whose task was to reconnoitre and make delaying attacks by each dropping 12 x 40 lb or 16 x 20 lb fragmentation bombs and assisting the Army formations to which each squadron was attached.

Within the anti-invasion *Plan Banquet* devised in May 1940 use was to be made of Blenheims, Battles, Wellingtons, Ansons and aged Hart variants serving at training units. They would move to operational stations and probably during one way missions tackle enemy lodgement areas. An extension, *Plan Banquet Light*, required 70 Flights each comprising five Tiger Moths or Magisters flown by instructors and drawn from fifteen EFTSs, each training carrying eight 20 lb fragmentation bombs. Sections of these aircraft were attached to Lysander squadrons and instructed to bomb level or to dive bomb troops as they set forth from their landing areas. To achieve that they would have needed to survive booby trapped and land mined zones before entering areas where burning petrol would have been sprayed from pipes hidden along the sides of roads. Not exactly a friendly welcome!

Discovering the extent of invasion build-up was mainly undertaken by the PRU Spitfires. Formed from the Development Unit, the PRU had split into four Flights on 1 July, one at Wick, another at St Eval and two at Heston, all of which were primarily watching enemy shipping. In July 57 sorties out of 78 provided very useful photographs, but it was not until late August that the rapid build-up of the invasion force was obvious.

On 7 September Spitfire N3117's photographs showed 270 barges in Ostend alone. Later that day, as London's dockland was heavily bombed, the Chiefs

of Staff, knowing tidal states favoured an invasion between 8 and 10 September, ordered Alert No 1. At 1907 hrs 'CROMWELL', meaning invasion imminent, was flashed to Army Commands in the south-east and GHQ Reserve. A few Home Guard units, finding out about the signal, prematurely rang church bells warning the public, but traumatic alarm was rapidly stopped.

As the Services took up their defensive positions 26 Hampdens were bombing the invasion assembly at Ostend, 13 Blenheims were attending to Dunkirk and a force of eleven Battles attacked the sea craft at Calais. All showered HEs and incendiaries on shipping concentrations. Shortly before midnight Bomber Command gave the signal 'ALERT 1' invasion expected within the next 24 hours, which meant that all aircraft not already required for operations during the next 12 hour period must immediately be bombed up, refuelled and placed at three hours notice. Station defence personnel stood ready for immediate action alongside the bombers, in the case of Hampdens each one carrying 6 x 250 lb GPs with a 250 lb AS bomb beneath each wing. Battles, loaded with 4 x 250 lb GPs, stood by to operate at dawn. A large anti-invasion air force awaited the assault, but it did not come.

Mid-morning of the 8th saw K9787, the very first production Spitfire and now a photo-reconnaissance machine, peer through the Channel haze in a none too successful attempt to photograph enemy movements between Zeebrugge and Boulogne. There was nothing to suggest the enemy was putting to sea.

Next night despite rain, low clouds and thunderstorms, Bomber Command began heavily bombing shipping assembled in the closest Channel ports, Wellington crews aiming 59 x 250 lb GP bombs on Boulogne. Thereafter and nightly Antwerp, Boulogne, Calais, Dunkirk, Flushing and



Blenheims suffered badly, with 56 lost on bombing missions over France in mid-1940. PRM

Ostend were usually hit along with the German ports of Bremen, Emden, Hamburg and Kiel from where warships were expected to sail to protect transports conveying the troops to Britain. Small forces meanwhile continued trying to cause inconvenience within the Fatherland and dropped the latest leaflets confirming their presence.

A second 'ALERT No 1' was called on 15 September. That night No 83 Squadron bombed Antwerp and one of the Hampdens was hit in the bomb bay by anti-aircraft fire. The ensuing fire was fought for ten minutes by Sgt John Hannah despite the heat and exploding ammunition, a courageous effort for which he was awarded the Victoria Cross. As for the invasion forces, again they had not put to sea. German bodies washed ashore in Britain were victims of training incidents. Whenever conditions permitted, PRU gathered photographs revealing the latest situation. On 18 September 1,004 barges were seen in Flushing alone, post-war captured German returns showing that on 21 September 2,342 barges, 386 tugs and 174 transports were available for Bomber Command to destroy. Then repeated reconnaissance flights, 138 effective sorties flown in September

1940, began suggesting that the numbers were falling and by the end of September 691 were in Flushing.

If all efforts failed to prevent the enemy gaining a foothold would the British have resorted to releasing a gas attack? The answer has always been 'Not before the Germans did so'. What is certain is that elaborate plans and extensive training for its use were enacted. Nos 2, 4, 26, 225 and 614 Lysander squadrons were all trained in gas spraying, each squadron being issued with 50 250 lb Smoke Curtain Installation canisters suitable for gas or smoke. Flying low, a dense cloud could be released about 60 yards wide and 600 yards long. Blenheim crews, No 142 Battle squadron and No 9 Wellington squadron had by October 1940 been trained to lay gas curtains.

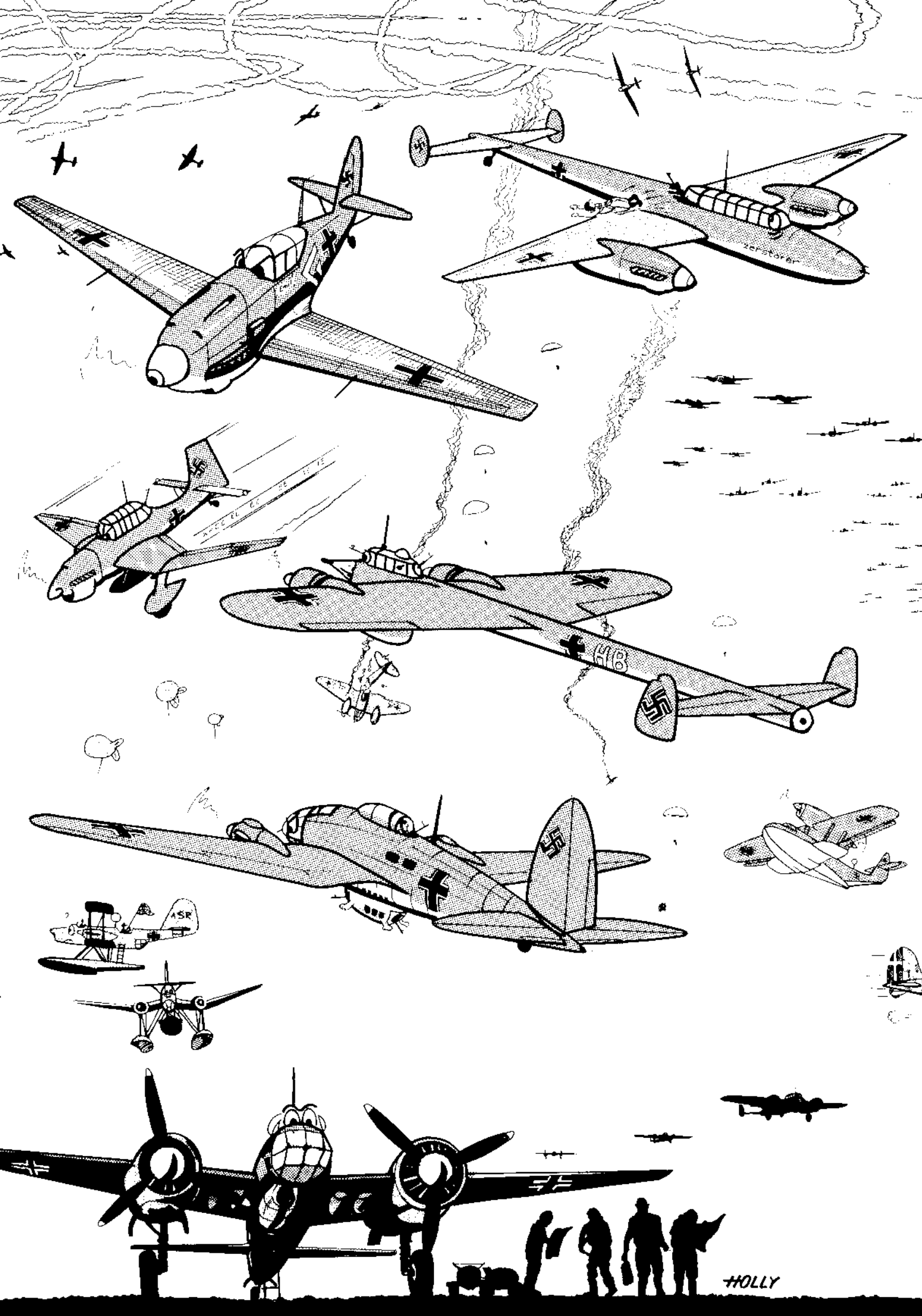
By then the immediate scare of invasion was waning, the bombing of its means of arrival having been effective. On 7/8 October a plan for the RAF to back-light Calais with incendiaries while a naval bombardment took place was cancelled. It was not the only event called off at the last moment. On 12 October Hitler ordered the invasion to be postponed and abandoned his Operation Sealion in January 1941.

The Lysander's slow speed was only an advantage for covert operations; in May-June 1940 34 were lost on reconnaissance tasks. PRM



BATTLE of BRITAIN 1940





HOLLY

PIRATES

OF THE NORTHERN SEAS

Paul Jackson visits the recently rejuvenated Buccaneer Force at RAF Lossiemouth

From only 100ft and at 540kt (622mph), the cold sea looks frighteningly close. In loose arrowhead battle formation, three Buccaneers streak over the white wave-tops, a further trio of their companions just in view 5,000yd away beneath a squally sky. Under their wings nestles a total of 22 Sea Eagle anti-ship missiles. Grey-painted missiles; green and grey aircraft; green-grey sea; black-grey clouds — and somewhere ahead, a group of grey 'Orange' warships. But where exactly?

The answer comes from a Nimrod maritime patrol aircraft which has been overshadowing the opposing vessels from

the relative safety of its maximum radar range. Co-ordinates are signalled to the attacking force as it makes its stealthy approach beneath the ships' radar horizon. Unfortunately, the Buccaneers are not the only ones with friends in the vicinity. The naval task group has its radar eyes in the form of an E-3A Sentry, which is also standing well back from the potential fray, and is even now directing a pair of Phantom interceptor fighters towards the incoming raid. Battle formation allows the Buccaneers to watch behind each other's vulnerable rear sectors, and as the first fighter is

sighted, radio silence is broken with the cry of 'buster' (maximum speed).

Slamming throttles forward, the Buccaneers accelerate to 580kt (668mph), spreading out and jinking to shake off the defenders. There is not a lot of manoeuvring you can do at 100ft, but high speed flight in the dense, bumpy air just above the wave-tops is precisely for what Blackburn Aircraft designed its now-ageing pirate. Though it may not be able to elude all the unwelcome company, the 'Bucc' can still out-run more than a few fighters when down amongst the seaweed.

The alarm over, the force splits into two for a pincer-type attack. Five minutes later, the pair of arrowheads turns inwards, towards the opposing warships, navigators calculating precisely the time and position for missile release. If the sums have been done correctly, all 22 Sea Eagles will tear apart the major vessels in the centre of the group at precisely the same moment, so swamping the defences with two volleys approaching at 90° to each other.

Of course, this is just a NATO exercise, so instead of turning for base on missile release — for Sea Eagle can be left to its own devices once off the pylons — the Buccaneer force continues ahead. Now, each aircraft represents up to four sea-skimming weapons, each programmed to search-out the high-value-ships and hole them at the water-line. After several more minutes, dots on the horizon become recognisable shapes, then loom large in the windscreen frame as the aircraft fly



Even 30 years after its first flight, the Buccaneer remains one of the best aircraft for low-level over-water operations at high subsonic speeds. RAF Lossiemouth





A quartet of Lossiemouth based Buccaneers high over the North Sea. Keith Wilson/Aviation World

through (not over!) the group of vessels.

A tight, sustained 3g turn, and the formation returns in line astern, seemingly passing below mast height, this time more in salute than in deadly earnest. Course is now set for home — Lossiemouth, on the sometimes bleak coast of Moray, Scotland — and soon Buccaneers, fighters and warships will be digesting the lessons of today's exercise. The practice has been valuable for all, not least for the squadron perfecting its techniques with the new Sea Eagle.

Notwithstanding the arms reductions and follow-up offers which have enraptured both halves of Europe in recent months, the workers at Nikolayev shipyard have not slowed down their fitting-out of the Soviet Navy's first major aircraft carrier. At Saki aerodrome, testing continues unabated of a new generation of hard-hitting, effective naval combat aircraft to be based on board the carrier and able to roam the World's oceans. The Lossiemouth Buccaneer Wing is not seduced by 'glasnost hysteria'. They know the Soviet Navy is getting bigger, better and stronger.

Lossiemouth is home to the RAF's last two operational Buccaneer squadrons, Nos 12 and 208, plus their associated

training component, No 237 Operational Conversion Unit (OCU). First flown in 1958, the Buccaneer entered Royal Navy service in 1961 (at 'Lossie'), but the first RAF squadron (No 12) did not form until 1969. The Service fought hard and long against adoption of a naval aircraft, but once the demise of the TSR2 and its supposed replacement F-111 proved the move essential, it rapidly developed a strong affinity for the Buccaneer. Replaced by Tornados in the over-land strike/attack role, the aircraft is once again totally assigned to over-water operations for which it is so ideally suited. Discovery of serious fatigue cracks in part of the fleet during 1980 failed to shake the RAF's faith in the Buccaneer's abilities, so in the latter part of the 1980s, an upgrading programme was introduced to keep two squadrons flying with effective armament for up to a further decade.

Strike Command's maritime component, No 18 Group, administers the Buccaneer force and its associated Nimrod patrollers. Operating from Lossiemouth, Buccaneers can reach as far as Norway's North Cape without refuelling in a HI-LO-HI mission profile, so presenting an effective barrier to any

naval force attempting to enter the North Atlantic via the Greenland-Iceland-UK gap. Almost all aircraft are of the S2B variety, with changes including wider-spaced under-wing pylons to allow carriage of (originally) Martel anti-ship missiles. A few non-Martel S2As remain, however — notably with the OCU. Advancing age of the airframes puts increased pressure upon the maintenance staff at 'Lossie', this further exacerbated by the need for continued vigilance in case the punishing low-level flight regime provokes further structural problems.

Operating out of two hardened aircraft shelter complexes (whilst the OCU has a more convenient hangar and traditional flight-line) the two Buccaneer squadrons until recently had slightly different responsibilities within the broad role of anti-shipping missions with conventional or WE177-type nuclear weapons. Both flew with the AS.37 anti-radar version of Martel, which homes onto emissions from transmitters. A fire-and-forget weapon, it simply presents radar-equipped vessels with the option of 'shut up, or be blown-up'. A further version, AJ.168 TV-Martel, was a No 12 Squadron speciality. Here an extra TV screen in the Buccaneer's rear cockpit allowed the navigator to



Wing-folding remains a feature of the Buccaneer in RAF service. PRM



guide the weapon to its target through a TV camera in the missile's nose. TV-Martel has just been withdrawn, but AR-Martel will continue in the armoury of both units.

No 208 also keeps its secondary capability of designating for, and dropping laser-guided 'Pavey' bombs weighing 1,210 lb. The AN/AVQ-23E Pave Spike designator pod is located on pylon 1, the port inner, and gives the navigator a view of the target on the TV screen also used for Martel. A laser beam along the same line of sight as the camera is therefore reflected from the designated aiming point, and can be homed onto by Pavey bombs. For maximum security of the attacking force, bombs can be tossed into the cone of reflected laser energy by a pull-up manoeuvre well short of the target.

Typically, six Buccaneers form a LGB (laser-guided bomb) mission, two of them designators with Pave Spike, plus a slipper tank for extra fuel on the inboard port wing pylon, a self-defence AIM-9G or 9L Sidewinder air-to-air missile outboard left and a Westinghouse AN/ALQ-101(v)-10 jamming pod outboard starboard. In the unusual rotating-door bomb-bay are four 1,120lb retarded bombs, with parachute-type tails. These internal bombs are only used if the four aircraft with LGBs under their wings are unsuccessful, but they are very useful for a 'Bif'. This most appropriate acronym stands for bomb-in-the-face, being a tactic used to upset a pursuing fighter pilot or his missile by exploding a bomb in the flight-path.

The recent enhancement of Buccaneer capabilities stems from a decision in the early-1980s not to assign two Tornado squadrons to NATO's Supreme Allied Commander Atlantic (SACLANT), as at first planned. A running-on of the Buccaneer was proposed instead, in conjunction with updating. Financial constraints prevented the whole fleet from having the comprehensive refit originally intended, so a simplified programme for 42 aircraft was decided upon, designated Air Staff Requirement

1012. These have been passing through BAe's plant at Woodford, near Manchester, between 1986 and 1989, although the first aircraft was actually re-worked at its birthplace — Brough, North Humberside.

Changes include installation of a Ferranti FIN1063 inertial navigation system and an interface between it and the original Ferranti Airpass III Blue Parrot nose radar. A new Louis Newmark Ltd Automatic Flight Control System replaces the older AFCS, and there are new Plessey radios. Enhanced defensive measures include updating the Marconi ARI18228 radar warning receiver to Guardian 200 standard. This involves re-fitting the small outboard leading-edge pods once used for the wide-band homer, these now housing the E-J band receivers for Guardian. The original fore and aft antennae at the fin/tailplane intersection are retained for C-D band sensing.

Presenting more accurate and detailed information on opposing radars which may be 'painting' the aircraft, Guardian is judged by crews as a useful aid even though it is not tied-in to the ALQ-101 jamming pod or the newly-installed chaff and flare decoy dispensers. These are four Tracor AN/ALE-40 units: two under the rear fuselage for flares (attracting heat-seeking missiles) and one scabbled to each inside edge of the outboard wing pylons for chaff (to lure radar-guided weapons). Lastly, though by no means least, aircrew personal equipment includes the Cam Lock Ltd AR5 respirator for enhanced protection against nuclear, biological or chemical contamination during transit between the filtered air of the Personnel Briefing facility and the aircraft's oxygen system. Separate to ASR1012, though running parallel, Buccaneers have been passing through the maintenance unit at Abingdon, Oxon, since 1987, for a major airframe refurbishment lasting 83 days and involving 17,000 man-hours of work. This is repeated on each aircraft approximately every five years.

By far the greatest enhancement of capabilities comes from the BAe Sea

Eagle anti-ship missile, four of which may be carried beneath the wings. Not a solid-propellant rocket like Martel, Sea Eagle — 'CE' for short — employs a small jet engine to give it a range of over 68 miles. Martel's problem is that its reach is less than that of current Soviet shipborne anti-aircraft missiles, whereas 'CE' can be launched with greater impunity. As its launching aircraft turn for home without having seen the target — perhaps not even on their radars, when there is a Nimrod radioing position data — the missile homes itself onto the large, high-value targets within a group of ships. Sea Eagle became operational with No 208 Squadron early in 1986, whilst No 12 Sqn followed exactly four years later. AR-Martel, or even LGBs, can be used against lightly-armed single vessels scouting at the edges of a naval force.

In its updated form, the Buccaneer has become a highly-effective weapon. Visitors to Lossiemouth might expect to hear crews urging that the aircraft be scrapped and replaced by Tornados. Not a bit of it. Opinion is that for anti-shipping strike/attack, the 'Bucc' has no equal. But what about the time when the airframes expire with old age? 'Build some more and fit them with modern equipment throughout' is the unanimous rejoinder. There is more to this than blind loyalty, for the Buccaneer is a remarkably fast and stable weapons platform at ultra-low level.

Sea Eagle and the new INS allow an attack by six aircraft to be undertaken with great precision in timing for maximum saturation of the short-range defences which will attempt the difficult task of shooting-down 22 missiles as they close-in from different directions just above the waves (22 because the other two pylons carry Sidewinders). Such attacks can be mounted at greater range than the Tornado because of generous fuel provision. To the normal tankage is added a further 425gall in a specially bulged door to the bomb bay, and if no internal weapons are carried, another 440gall can replace them. Two slipper tanks on the inboard pylons hold 200gall each, if external weaponry is reduced.



Far left top: No 208 Squadron flies its Buccaneers from the southern hardened aircraft shelter complex at Lossiemouth and was the first to receive Sea Eagle missiles. BAe

Far left bottom: Hawker Hunter T7s and 8s continue to play a vital role in training pilots to fly the Buccaneer. RAF Lossiemouth

Left: Early morning mission. The sun rises behind a Buccaneer trailing a 'buddy' refuelling hose to replenish its companions. Paul Jackson

Thus, a Buccaneer taking off at a typical 53,000lb (23.6 tons) can be carrying 19,400lb (8.7ton) of fuel internally, and still have four pylons free for a reduced weapon load. Four Sea Eagles at 1,325lb each, plus full internal fuel, is just possible within the maximum permitted weight of 59,000lb (26.3 ton). Fixed in-flight refuelling probes allow for a greater reach. As well as the usual Victor or VC-10 tankers, the Buccaneer can become a tanker for its compatriots by fitting a FRL Mk 20C or 20E hose-pod on the starboard inner pylon.

Admission to the elite Buccaneer force is via No 237 OCU. Only pilots and navigators attaining the highest standards at TWU and No 6 FTS, respectively, are considered for posting to No 237 for a 23-week course, the first two of which are in the Ground School. For pilots, the equivalent of 13½ flying hours is spent on the Buccaneer simulator, but as there is no dual-control version of the aircraft, the first six real flights are in a Hawker Hunter two-seat trainer. Seven of these aircraft are on the OCU strength (and a few more with the squadrons), three of them standard T7s for type conversion.

Having mastered the T7, pilots fly the remainder of the introductory sorties on a T7A and three ex-naval T8Bs, all of which have Buccaneer-type cockpits on the left side. This, the IFIS (Integrated Flight Instrumentation System) is readily distinguishable by the 'Austin 1100' strip-reading airspeed indicator fitted in

Buccaneers (and Lightnings) in place of the usual dial. The T7A additionally has ILS for poor-weather landing training, and the T8Bs the Buccaneer's Airflow Detection Device (ADD) which gives pilots a steady tone in their earphones when the aircraft is at the correct angle (for speed and weight) on the landing approach.

At last, it is time for the pilot to climb ('mountaineer' might be a better word) into the mighty Buccaneer's cockpit for a first sortie, with a staff pilot in the back seat. The latter has only the benefit of a few basic instruments and is therefore limited to providing verbal encouragement for the novice. This hurdle over, it is still only at the fifth sortie that pilot and navigator team-up for the first time, although they regularly split to receive individual tuition throughout the course. Navigation exercises are next, followed by precision weapon delivery profiles in which permitted margins of error are ±5kt at 480kt and ±5ft at 200ft altitude. Evasion of attacking fighters, night flying and maritime tactics complete the training, giving pilot and navigator 56hr 45min of training each — excluding seven Hunter and 27½ simulator hours for the pilot. Because there are some separate training periods, 107¼ Buccaneer hours are needed for each complete crew.

Procedures are the same for crews coming from another type of aircraft — notably the Canberra — although abbreviated refresher courses are

provided for former Buccaneer personnel returning to flying after a tour of duty at a desk. Once posted to a squadron, crews take 6-12 months to become combat-ready, having worked with their more experienced companions in practice attack missions with Sea Eagle, the other weaponry and in tanking. OCU crews have their own combat role, in that they are committed to RAF Germany to provide laser-designation for the Tornado GR1s of Nos 16 and 20 Squadrons and aircraft of certain other NATO nations. The OCU's non-updated S2A aircraft would be useful to the squadrons as tankers, but their peacetime roles include keeping navigators from being too reliant on the 'magic writing' generated by the S2B's inertial equipment.

Continuation training on Nos 12 and 208 Squadrons includes regular sorties of up to two hours' duration incorporating bombing with Portsmouth Aviation 3kg and 14kg practice bombs carried in a Hunting CBLs 100 Mk 3 pod, using the Tain and Rosehearty ranges. Various Sea Eagle launch tactics are rehearsed, and fuel taken from several types of tanker. During the summer, when Scottish nights are short and never properly dark, squadrons detach to Cyprus to practice night flying. For the benefit of RN ships preparing to sail for the Arabian Gulf, Buccaneers simulate shipping attacks from the specially-authorized height of 50ft. With only a radar altimeter for guidance, this is a most demanding regime, in which anything other than straight and level flying is possible.

What, then, of the future for the Buccaneer? Though sturdily built, the aircraft have now flown as many as 5,000hr and exceeded their originally-predicted fatigue lifetimes by at least a factor of two. The cost of keeping them structurally sound will prove the deciding factor, although at least a further half-dozen years of Buccaneering may be confidently predicted. When SACLANT finally loses his last Buccaneers, NATO navies will regret the withdrawal of a potent ally — but the RAF will mourn the passing of a highly respected friend.

No 12 Squadron Buccaneer S2 XX894 in a special paint scheme to mark the squadron's 75th anniversary on 3 March 1990. Military Aircraft Photographs





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WRAF

50 YEARS OF SERVICE

Flight Lieutenant Ken Delve looks back over 50 years of the Womens Royal Air Force and forward to an exciting new chapter in the 90s

On 28 June 1939 the Royal Warrant brought into formal existence the Womens Auxiliary Air Force, opening a period of 50 years continuous service for women as an integral part of the Royal Air Force. However, this is not the full story as a short but intensive period had already been undertaken in the closing years of World War One.

With the outbreak of WWI in 1914 a number of volunteer women's groups, such as the First Aid Nursing Yeomanry (FANY) and Volunteer Aid Detachments (VAD) were soon involved in providing support for the military. However, by late 1916 a shortage of manpower caused by the huge losses of the first three years of the war led to consideration of ways of releasing men for

front-line duties from support units.

A conference of women's societies held in London in February 1917 led to the creation of the Women's Army Auxiliary Corps (WAAC) and the following month the first part (14 cooks and waitresses) left England for France. The Corps expanded rapidly, including the posting of members to Royal Flying Corps (RFC) and Royal Naval Air Service (RNAS) stations although, at first, they were mainly employed on clerical duties. In January 1918 sanction was given for the creation of a new arm of the women's service to work with the proposed independent Royal Air Force and so on 3 March 1918 the Women's Royal Air Force was given its name.

Initial recruits came from the WAAC and

WRNS already working at the air stations and they were given the option of joining the new service or being posted! By 1 August WRAF strength stood at 15,433 5,000 new recruits and 10,000 transfers. The plan was for a service of 90,000 women but the peak proved to be around 25,000. This meant a tremendous organisational task with recruitment, training and equipment all needing urgent attention. Inevitably there were problems although, in general terms, the WRAF overcame most of them by dint of its determination to be a success. In official terms women have been enrolled in the WRAF with the object of enabling them to assist in the war by releasing men for duty at home and overseas'. This led to a careful examination

Top left: A not very glamorous pose, but indicative of the wide range of jobs which the WRAF was called upon to perform. RAF Museum Top right: The classic situation for the WRAF of WW2 - plotters and controllers in a sector ops room. RAF Museum Centre: Inspection of a barrage balloon section. A great many sites were manned by the WRAF. RAF Museum



Operating early radar for air defence - as depicted in the RAF Museum. PRM



WRAF personnel served worldwide after WW2. Here a telephonist at RAF Changi meets the Director WRAF in 1959. RAF Changi



Master Air Loadmaster Joy McArthur and Flight Sergeant Issy Booker on board a Lyneham based Hercules. Ken Delve

of those areas of the RAF where women could be employed and the creation of a trade structure based on four main categories of trade: clerks and storewomen, household workers, technical trades and non-technical trades. Within these there were many sub-divisions so that no less than 40 options were available, although this very quickly rose to in excess of 50! Category A, the clerks and storewomen, managed mountains of paperwork and in many ways could be described as the backbone of many stations as the RAF ran, as it still does, on paperwork! The elite amongst this category were the shorthand typists. Category B, the household section, performed many menial tasks for which little recognition was forthcoming long hours, unsocial shifts and low levels of pay. Category C contained a diverse range of trades many of which had been considered unsuitable for women but at which they proved themselves most able. Trades within this band went from welders and coppersmiths to riggers and engine fitters. Category D was a 'catch-all' to cover the many unskilled jobs from general labourer to telephonist or motor cyclist!

The basic structure of the WRAF was modelled upon that of its male counterpart although there were many significant differences, not least being the legal standing of a member of the WRAF. Pay varied from less than 10 shillings to 31 shillings depending on trade and rank for example, a pantrymaid was paid 10 shillings a week, a Grade I Section Leader Fabric Worker 15 shillings a week and a Grade I engine fitter 18 shillings a week.

The WRAF buildings were often isolated in one part of the station and at times even had wire fences around them, the Service seeing itself as the guardian of the moral

welfare of its girls! Some did not like the discipline and shared way of life but for most it was a fascinating experience and one they found very enjoyable.

Just as the WRAF was finding its feet and ironing out its difficulties it was rumoured that it would disband following the end of the war with the Armistice being signed in November 1918. However, it was decided to include women in the Army of Occupation and in March 1919 the first WRAF personnel deployed to France prior to moving on to Germany in May. By September over 1,000 were in France and Germany. It proved to be very short-lived as by October they had left Germany and by the following March the last girls left France. In the UK it had been a similar story, the great post-war rush to disband included the women's services and the WRAF numbers reduced rapidly until by 1 April 1920 only four were left! They too were soon gone, bringing to an end the first part of the story as despite strong pressure for a peacetime women's corps there was no official backing for one.

It was almost 20 years before the 'call to arms' came once more and women took their place alongside men in the service of their country. During the mid 1930s, with growing tension throughout Europe, a number of volunteer women's organisations began to spring up. In May 1938 official recognition came with the creation of the Womens Auxiliary Defence Service (WADS), although the name was almost immediately changed to Auxiliary Territorial Services (ATS). Recruiting commenced immediately and, by applying some of the lessons of 1917, proceeded fairly smoothly.

The RAF policy was to affiliate its' ATS sections to Auxiliary Air Force (AAF) units to provide them with a rather more air-orientated environment. The first RAF

Company was the City of Aberdeen Company and within a short space of time there were 48 RAF Companies. During 1939 they gradually became more RAF than ATS and it was inevitable that they would move closer to their parent Service. This was recognised on 28 June 1939 with the Royal Warrant creating the WAAF. In many ways it was the 1918-20 story all over again, but on a much bigger scale and with even greater diversity of trades open to the girls of the WAAF. There was a great demand from RAF stations for WAAF personnel even though many of them did not have the facilities to cope with such an influx. There were many problems during the first twelve months although in large part they were caused by the too-rapid expansion of the Service inadequate training facilities, lack of equipment, especially uniform, and poor facilities at the stations, but the determination to make the whole thing work was still there. 'Freezing cold, no water or heating for long periods, cold food, inadequate clothing, but wonderful people.' Age limit for recruits was 18-43 with a requirement to sign on for four years or the duration of the war (the age limits were changed to 17½-44 in 1941). The immediate pre-war strength of 1,734 rose to a peak of 181,835 by 1943, helped by the fact that from 1941 compulsory call-up had been introduced for women.

The list of trades open to the girls of the WRAF became longer and longer many had not changed since 1919 but there were now more technical jobs. Cooks and domestics were in great demand, the hours were still long and the conditions variable (it was also a short-staffed area with only three cooks per 1,000 men); MT drivers had an exciting time driving a diverse fleet of vehicles of up to 30 tons and having to find their way

around the country without signposts. Amongst the new trades the one that is most often associated with the girls of the WAAF, because of the depictions of the film industry, is that of fighter control plotters. Although in official terms they were Clerks (SD) Special Duties the plotters and radar operators and their job(s) were much more complex, involved and responsible than is often implied by the films. This work also put them in the front line as radar stations and sector control became a prime target for the Luftwaffe. By 1944 most of the operators were female. Another of the new trades was that connected with the barrage balloon sites. By late 1941 all-women crews were manning sites and within months over 1,000 sites were WAAF manned. It was hard work, often of a very physical nature but the sites became tight-knit little communities (12 to a site plus 2 NCOs) and it was a popular trade. It would be impossible here to cover all the trades and sub-trades in which WAAF girls played such vital roles but it is true to say that in whatever they turned their hands to they proved to be successful often to the amazement of their male colleagues.

As confidence in their abilities grew so did the calls for more and more WAAFs and by 1944 postings to overseas theatres commenced, firstly to Egypt but then to Europe and even the Far East. There had, however, been a limited number of postings to secure areas such as the United States before this. The net result was that by late 1944 the WAAF was without a doubt a vital part of the RAF organisation. Fortunately, discussions had commenced in 1943 on the post-war future of the WAAF and it had been agreed all round that this time the women's service would not disband. Demob began in June 1945 and within twelve months over 100,000 had left the Service although many others agreed to extend their service into the peacetime WAAF. The next four years were very much a transition period, dominated by the continued run-down of strength (by 1 January 1950 the WAAF stood at 517 officers and 11,028 airwomen) but with vital decisions on the future of the service being made at the same time. Training depots re-opened and a new trade structure covering the proposed 31 post-war trades devised. Changes were

made in uniform style to bring the ladies into line with the styles of their male counterparts and every effort was made to integrate the two elements. On 1 February 1949 the permanent service was inaugurated as the Womens Royal Air Force (WRAF).

The 40 years since then have seen the girls of the WRAF serving worldwide with their male counterparts. The range of trades stayed as diverse as ever, new ones were acquired and old ones abandoned. As the RAF has withdrawn from many of its world commitments and reduced in size so too has the WRAF. Nevertheless it remains an integrated and essential part of the RAF and will continue to react to the changes required by a high-tech fighting service.

From the earliest days of aviation the female of the species has been as intrigued by flight and involved in its development as the male but it has been an uphill struggle to overcome prejudice against such involvement. The 1920s saw a great upsurge in private flying and the growth of flying clubs and women pilots and flying instructors were a common sight at the various air rallies in Britain. There were even a number of 'famous names' such as Amy Johnson with her record-breaking flights which did much to publicise the cause of female aviators. However, with the great rush to expand the RAF in the late 1930s no thought was given to the employment of female pilots hardly surprising really as the basic principle of bringing women back into the military in any fashion had not been considered seriously until 1938. With the incorporation of civilian flying schools into the RAF training net there were instances of civilian (female) flying instructors working on behalf of the RAF in training the new breed of pilots.

The dire shortage of pilots was only slowly being remedied and in May 1939 there was discussion on the employment of women pilots for such duties as aircraft ferry work. There were even suggestions that this organisation should be incorporated within the WAAF, but a definitive statement from the Air Member for Personnel put paid to this —'we do not want a flying section of the WAAF'.

It was a period of severe wrangling over what to call the new service, who it should

be responsible to and who should administer it. The reluctance of the RAF to take full control, and its express disinterest in having an aircrew branch of the WAAF, led to the creation of the Air Transport Auxiliary (ATA) in September 1939. The primary role of the organisation was that of ferrying aircraft from manufacturer to storage unit or station, or any combination of such and many trips ended up as three-way stages.

Experienced pilots were in such short supply that the decision was taken to recruit a selected group of highly experienced female pilots (much more experienced than many of their male colleagues) to form an all woman ferry pool section of the ATA under Pauline Gower. Official prejudice still existed and the number of female ATA pilots was limited, as was the list of aircraft types which they were allowed to ferry. In the early years they were limited to the light types such as Moths but gradually qualified for light twins. There was no doubt in their minds that they were capable of much more and as the war years progressed so did the status of the ATA women until by the latter years of the war they were cleared to fly just about everything. It came as a great shock to many hardened aircrew on a Bomber Command station to see one of the lady ATA pilots step down from a huge Stirling bomber! There could be no doubting their ability and determination and the contribution the 166 female ATA pilots made (along with their 1152 male colleagues) was significant. Over 300,000 aircraft were delivered by ATA pilots; probably the best known of the female pilots was Lettice Curtis who delivered just under 1,500 aircraft including over 370 'heavies'. In the latter part of 1943 the decision was taken to allow a limited number of WAAF to apply for pilot training and service with the ATA. This was a direct result of the ATA requirement to recruit more pilots in this critical period and the plan was for those chosen to be released to the ATA rather than simply seconded from the WAAF. By October 1943 there were over 150 applicants but progress was slow and little happened over the next year or so.

Certain of the aircraft types being ferried required the services of a Flight Engineer and of the total of 151 ATA Flight Engineers

Today many more members of the WRAF can be seen on RAF flightlines and working directly with aircraft than a decade ago. Ken Delve



Air Loadmaster at work aboard an RAF VC10. Ken Delve



four were women. The ATA, a unique phase of British aviation history, came to an end in November 1945. (As an aside it is worth noting that the Soviet Air Force employed female combat crews in its own air regiments. By all accounts it was a very successful policy with some pilots completing almost 2,000 missions.)

With the passing of the ATA there was no thought of women pilots being required by the rapidly contracting post-war RAF. However, in May 1948 fourteen pilots from the newly established WAAF VR (Flying) Branch attended a weekend refresher course and so became the first WAAF personnel entitled to wear a flying badge. Significantly, all of them were ex-ATA. This was a fairly short-lived 'experiment'.

The discussion on the employment of female aircrew within a military establishment has been almost continuous since the end of WWII. Gradually various nations have accepted the principle and many of the major air forces now have female aircrew; however, very few of them fly 'operational' types (ie fighters and

bombers). One of the primary reasons put forward to support this has been that 'the female body' cannot support the acceleration forces of modern combat aircraft. As with virtually all scientific 'fact' there are two schools of thought on this the USAF has just acquired its first lady test pilot. The other supporting case is that of training costs against productive service. You can't spend millions training a pilot if she then wants to leave and get married. This old chestnut has also been thrown out of the window in the light of experience.

Both of the above arguments have been used in the past by the RAF to counter the regular questions on why women were excluded from aircrew training. Historical evidence has shown that both premises were false. The first members of the WRAF to fly as part of an aircraft's crew were the stewardesses of the Transport Command aircraft; officially they were part of the new Air Quartermaster trade opened to women in 1959. Three years later the trade was awarded aircrew status and the ten women under training at that time became the first

to wear a flying brevet. Another change came in October 1970 with renaming as Air Loadmasters and in 1973 the first female 'Loadie' was commissioned in the General Duties (Flying) Branch. The choice of aircraft was very limited but a significant breakthrough came in 1981 with the first course going on to the Hercules. The really dramatic change came in 1989 with the decision to recruit female aircrew as Pilots, Navigators and Air Engineers.

The aviation press first caught wind of the changes at the beginning of the year with a statement by the Chief of the Air Staff, Sir Peter Harding, revealing that 'we are looking at broadening their (ie WRAF) role and studies will be undertaken to see whether they could be employed as pilots and navigators. It has not been our policy to use women in combat roles and we could not have them as fighter pilots, but they have proved impressive in the University Air Squadrons.' The official notification that the theory was about to become practice was made in early summer 1989 with the news that up to 10% of the annual intake of 250 pilots and 100 navigators could be taken up by female applicants. Along with the notional 25 pilots and 10 navigators per year the initial policy includes provision for up to eight Air Electronic Operators and four Air Engineers per year. It also confirmed that the choice of aircraft would be limited to those not carrying offensive weapons, in other words, training and support aircraft plus certain operational types. The only 'fast-jet' in the list is the Hawk and then only at the advanced flying training (AFT) phase.

RAF Finningley welcomed the first three of the new breed on No 381 Air Navigation Course in September 1989 Fg Off Wendy Smith, Plt Off Sally Hawkins and Plt Off Anne-Marie Dawe. All three had taken advantage of the internal transfer system to apply for the new posts and came from such diverse backgrounds as Bloodhound controller and admin/supply. With six months of the 15-month course gone the ladies seem to be enjoying themselves; the academics are out of the way and the Dominie flying is well underway.

The second course to include female navigation students has recently commenced training and our first graduate (if all goes well for the remainder of the course) should receive a Nav brevet in March 1991. To date the pilot empire is lagging behind that of the navigators and no women pilots are in training; the first course is expected to start early in 1990. The same holds true for the Air Engineer and Air Electronics courses, both expecting to see their first female students soon.

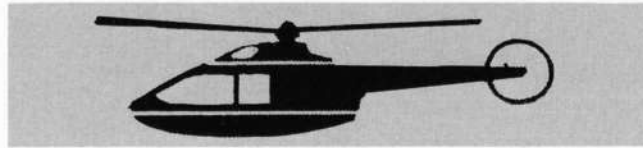
There can be little doubt that this latest change is a good one. Historically our female aviators have often outshone their male counterparts (it certainly keeps the male navigator students on their toes to have a bit of 'competition'). It will not be long before WRAF aircrew are seen climbing out of Hercules, Hawks, VC10 tankers and others at air shows around the UK. How long will it be before they are also to be seen in the fighter types after all, Canada has just started training its first female combat pilots. This is just the first chapter in this new part of the RAF/WRAF story.



Above: Fg Off Wendy Smith, Plt Off Sally Hawkins and Plt Off Anne-Marie Dawe are on course to be navigators at Finningley. RAF Support Command



Left: The first two student pilots, pictured here in January 1990, are Fg Off Jackie Chapman and Fg Off Christine Martin. RAF Support Command



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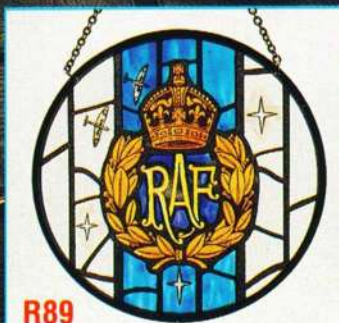
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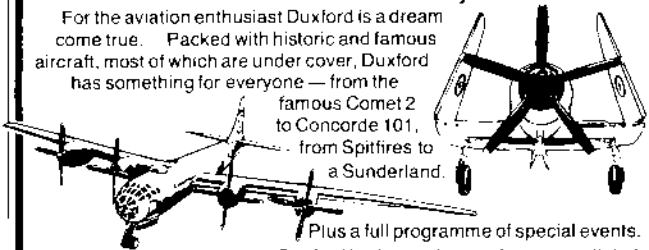
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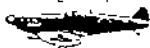


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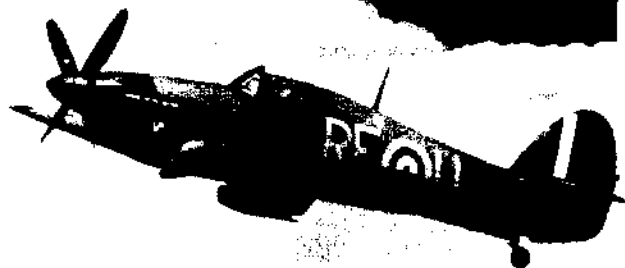
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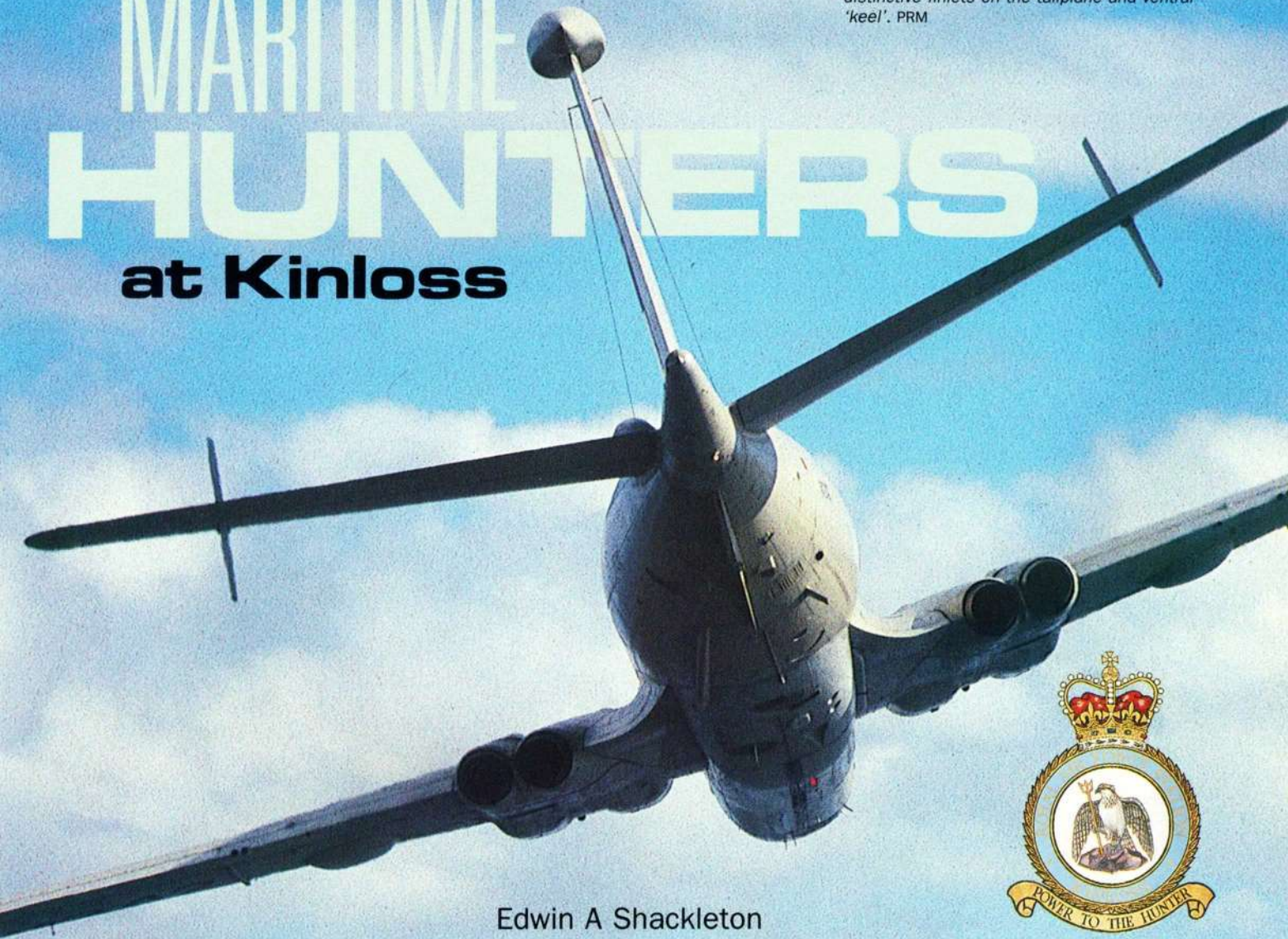
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RYB 1

MARITIME HUNTERS

at Kinloss

An unusual view of the MR2 showing its distinctive finlets on the tailplane and ventral 'keel'. PRM



Edwin A Shackleton

Situated on the Moray Coast east of Inverness, some 450 miles by air from central London is the Royal Air Force station of Kinloss. It was established on 1 April 1939, just 21 years after the birth of the Royal Air Force, as the threat of WW2 approached.

Local farms were requisitioned and construction began in early 1938. Such was the urgency that the first aircraft, Oxford N4584, landed at the new station on 9 May 1939. However, ground support was minimal and many personnel were living outside the camp in extremely basic accommodation. A pilot training unit, No 14 Flying Training School (FTS), was quickly

formed with a mixed bag of aircraft including the Hawker Hart, Hind and Audax, Oxfords, Ansons and Harvards. Two weeks after the activation, No 45 Maintenance Unit was moved to Kinloss and remained there until 1956. The FTS stayed only one year and was replaced by No 19 Operational Training Unit (OTU) which was equipped with Whitleys and Ansons to train pilots, navigators, wireless operators and air gunners. This continued until just after VE Day. Many of the Whitleys were ex-front line Mk III, IV and V. Despite serviceability and weather problems the station achieved an average 22,000 flying hours. No 3 OTU with Whitleys and Lysanders operated from

Kinloss throughout the same period. One of the first operational sorties by RAF Fortress Is was flown from Kinloss to Oslo and the base was also used by Halifax bombers against the *Tirpitz*.

German aircraft, particularly Junkers Ju 88s, were met by local defence measures but there were no organised attacks. However, a German 'invasion' occurred in 1946 when Kinloss was used as a transit base for prisoners of war returning from the USA to be repatriated.

Peacetime saw a change of role for RAF Kinloss and a long term association with maritime operations commenced. No 6 Coastal OTU arrived on 19 July 1945,

The Nimrod's powerful Searchwater radar is able to locate very small objects in the sea at considerable range. PRM





No 6 Coastal OTU brought Beaufighters to Kinloss on 19 July 1945.



A Neptune of No 217 Squadron based at Kinloss. Military Aircraft Photographs

equipped with Mosquitos, Beaufighters, Buckmasters, Brigands and Lancasters. Two years later a change in duties for Coastal Command, which dropped the anti-shipping strike role, left the unit with just its Lancaster III's together with Spitfires for fighter affiliation training. It was then re-designated No 236 Operational Conversion Unit (OCU). No 45 MU had a particularly busy time disposing of aircraft after the wartime peak. The Mountain Rescue Team was also formed, giving invaluable service to both the armed forces and civilians in the inhospitable Scottish Highlands.

It was not until 1950 that Kinloss became host to the first front line squadrons when on 20 December Nos 120 and 217 Squadrons arrived with their Lancaster GR.III's. No 120 Squadron's Liberators had the distinction during WW2 of sinking a record number of 16 U-Boats, with many others damaged. Another milestone for this squadron came in April 1951 when it became the first operational unit with the Shackleton MR1. An intensive flying schedule over a period of 28 days was initiated during which the new machines flew 10-hour sorties. Another new type for the RAF, the Lockheed P2V-5 Neptune arrived at Kinloss in July 1952 when No 217 Squadron was brought up to full strength with this US-supplied aircraft (a trials unit with two Neptunes had been working at St Eval for several months). The high definition radar proved useful in a secondary role when weather was poor as the approach light poles were good radar reflectors — an early instrument approach system!

The School of Maritime Reconnaissance at St Mawgan, Cornwall merged with No 236 OCU to form the Maritime Operational Training Unit (MOTU) based at Kinloss. No 120 Squadron moved from Kinloss in April 1952 to Northern Ireland with its Shackleton MR1s and moved back to the Scottish base with the MR3 version in April 1959. A long-term resident, No 45 MU, finally moved out in late 1956, its last role being the overhaul of Hunters and Canberras. On 31 March 1957, No 217 Squadron was disbanded and its Neptunes

were returned to the USA.

The accommodation at Kinloss had not been particularly attractive, but the Station Commander from 1950-53, Group Captain D G Kiddie, was able to accelerate previous improvements. Many of the wooden buildings were replaced by brick over the next ten years. On 6 July 1962 the local Royal and Ancient Burgh of Forres honoured RAF Kinloss with the freedom of the town.

Two operational squadrons moved from St Mawgan to Kinloss with their Shackleton MR3s (No 201 Squadron on 14 March 1965 and No 206 Squadron on 7 July 1965) to join the resident No 120 Squadron while the MOTU moved to the Cornish base, becoming No 236 OCU once again. The three squadrons — Nos 120, 201 and 206 — remain at Kinloss today while No 42 Squadron and the OCU are based at St Mawgan.

Meanwhile, it had been obvious that the long serving Shackleton was due for replacement. Rather than purchase a foreign 'off the shelf' maritime aircraft or be committed to a completely new airframe design, a compromise was reached which has proved to be very successful. The Hawker Siddeley Nimrod was based on the structure of the Comet 4C airliner with a deeper fuselage to accommodate a weapons bay, extra tankage and higher power with four Rolls-Royce Spey engines in place of the Avons, to cater for the increased all-up weight. An aerodynamic prototype first flew in May 1967 followed by a production MR1 in June 1968. The Kinloss-based squadrons received their aircraft from the Woodford production line from October 1970. The Nimrod has been for more than two decades the only Western land-based turbojet maritime patrol aircraft.

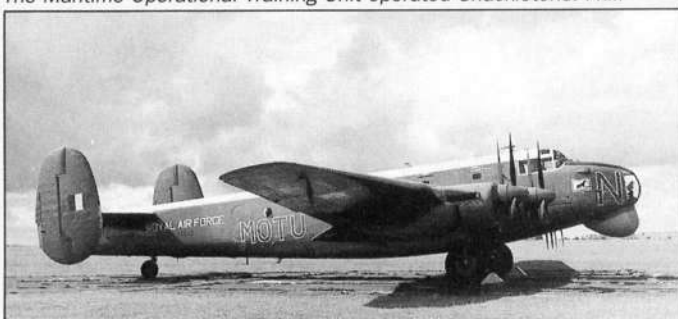
Ten years later, all of the squadron Nimrod MR1s were updated with the more versatile Searchwater anti-submarine radar, and improved acoustic equipment resulting in the redesignation MR2. Also in 1979, the first of the former grey and white Nimrods (XV246) appeared in the hemp colour scheme. The last was completed in 1983.

Another change, yet to be completed on all aircraft, was that the red and blue roundels were replaced by lower visibility 'faded' versions.

The Nimrod MR2 was suddenly brought into the reality of war when the Argentinean forces invaded the Falkland Islands in 1982. Some aircraft were quickly despatched to British Aerospace at Woodford to be adapted for in-flight refuelling. At the same time, Kinloss modified Nimrods to carry the new Stingray torpedo and high explosive (HE) bombs, while flight refuelling techniques were being mastered. An unusual modification was the adaptation of the Nimrod to carry Sidewinder air-to-air missiles and Harpoon Anti-Surface Ship Missiles. Very soon the modified MR2(P) machines were flown to Ascension Island and were tasked with the support of the Royal Navy Task Force that had been rapidly grouped and was steaming south towards the Falklands. Many long patrols were undertaken during the conflict, some of over 20 hours duration. The hard worked crews were recognised when three Nimrods took part in a victory flypast over London on 12 October 1982.

In 1990 the main duty of the Kinloss-based Nimrod MR2s remains anti-submarine warfare, which involves the constant monitoring of possible enemy submarines in the Atlantic and the Norwegian Sea. The Nimrod's Searchwater radar with its nose mounted scanner is able to locate small objects (such as a submarine mast) at long distance and establish target range, speed and, given sufficient time, a radar image. Sonobuoys are used for underwater detection. Passive sonobuoys are used to receive target signals and transmit to the Nimrod whereas the active sonobuoy transmits signals which are reflected from the target and transmitted to the aircraft. The processor systems are able to accept multiple signals and present a target location. A recent addition to the Nimrod capability is the installation of *Yellowgate* electronic surveillance system (ESM) which allows the operator to analyse radar transmissions

The Maritime Operational Training Unit operated Shackletons. PRM



Shackleton MR3s equipped No 120 Squadron at Kinloss from April 1959. PRM



from almost all NATO and Soviet radars.

Nimrod crews comprise two pilots (normally ranking from Squadron Leader to Flying Officer), one flight engineer, two navigators (one navigator who is involved in the aircraft geographical location and a tactical navigator who is involved in the target location and attack), one Air Electronics Officer and six or seven Air Electronics Operators. The AEOs are designated 'wet' for acoustic (underwater) detection and 'dry' for radar and ESM sensors (above water) and tactical communications.

The aircraft captain is selected by the Squadron Commander and is not necessarily the pilot in the left seat, but could be the Navigator or the AEO. They normally operate as 'constituted crews' which aids efficiency in that they work as a co-ordinated and experienced team. This will obviously vary with training, leave and sickness commitments. Continuation training is an important part of crew readiness. Two pilot simulators and two crew simulators provide a realistic form of training and although they are expensive their operating costs are considerably less than an aircraft flying a sortie and have important advantages. For example, simulated submarine targets can be provided and the crew can go through a search and attack routine in a realistic hostile environment. The Simulator Squadron is currently being re-equipped with new pilot simulators; the early type of visual presentation with models is being replaced by an extremely flexible computer generated presentation with full-movement all-axes simulation and will include flight refuelling training.

The Operations Squadron is responsible for the planning of the flight schedules for the three Nimrod squadrons. Worldwide operational commitments to work with foreign air forces on exercises or to participate in air displays, many hours from Kinloss, will mean detachments to such bases as Keflavik (Iceland), Bodo (Norway), Valkenburg (Holland), Gibraltar, Lajes (Azores), Sigonella (Sicily), Moffat (USA), Greenwood (Canada) and many others. Operational sorties are flown regularly over the North Atlantic and the North Norwegian Sea.

The Search and Rescue commitment, under the control of the RCCs at Plymouth and Edinburgh, requires a Nimrod on one-hour standby, 24 hours per day, 365 days per year, from one of the four Nimrod squadrons. In practice this means that the Kinloss base will be available for 75 per cent of the year, while the St Mawgan based No 42 Squadron will provide the balance.

A continual check is made on the cumulative hours of each aircraft and the time available before the next major inspection. Thus the completed balance, bearing in mind the aircraft serviceability, is adjusted to allocate Nimrods on a weekly schedule and re-adjusted daily to meet flying requirements. Maintenance of these maritime aircraft is carried out using centralised servicing and each squadron uses Nimrods from a central pool in a similar manner to that at RAF Lyneham with the Hercules fleet. This unit will carry out the daily/pre-flight checks on the aircraft



The HS Nimrod MR1 shows its unmistakable Comet ancestry. PRM

parked at the dispersals and also the minor inspection schedules in its own hangars. There is an impressive aircraft wash-down facility so that the effects of the salt corrosive atmosphere (both on the ground and in low altitude flight) can be appreciably reduced.

Concurrent with the introduction of the MR2 version, the Nimrod Major Servicing Unit (NMSU) was formed at Kinloss. The unit is based on the north side of the airfield and is responsible directly to HQ Strike Command. NMSU conducts the major overhaul of all Nimrod MR2 and R1 aircraft for the Royal Air Force and four aircraft are normally programmed for major inspection and overhaul at 2000hr intervals (this is scheduled to be increased to 2400hr). The programme totals 90 days overall and is governed by an extensive computer generated bar chart, firstly in the strip and removal of panels and components, then the detailed inspection survey followed by re-assembly and systems checks. Extensive use is made of modern non-destructive testing (NDT) inspection methods. A major fatigue test on the Nimrod structure was commissioned in 1984 at BAe Woodford which highlights any critical areas to be inspected and provides appropriate damage repairs for the operational aircraft.

Corrosion is a constant problem,

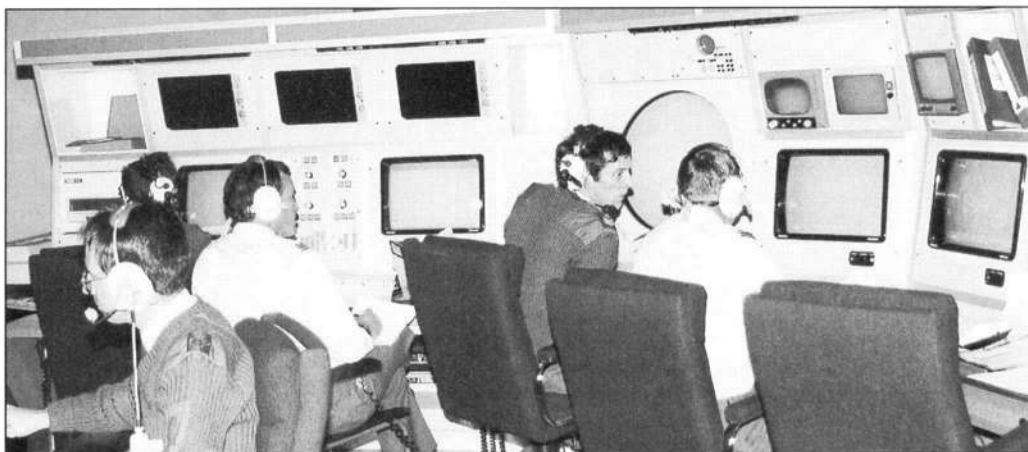


In 1982 Nimrods were hastily modified to carry these Sidewinder missiles for defence. PRM

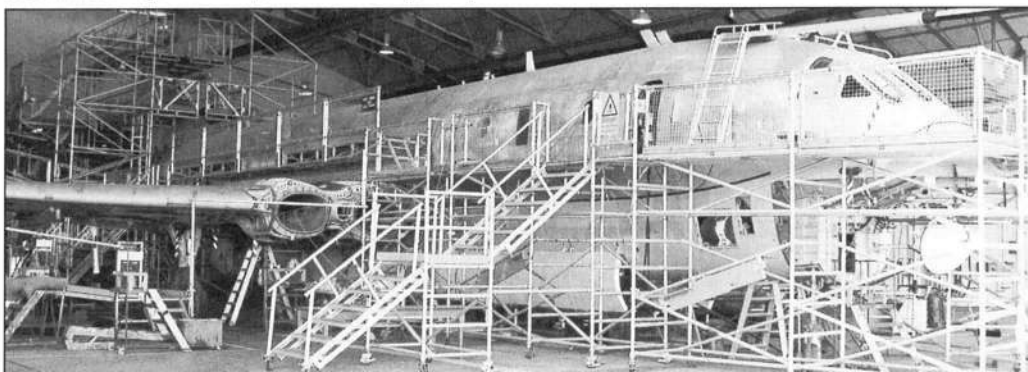
particularly in crack initiation. Standard repair kits are available but, where necessary, British Aerospace provide repair schemes and kits. The critical path operations are constantly monitored and re-adjusted to cover problem areas and to ensure no programme slip.

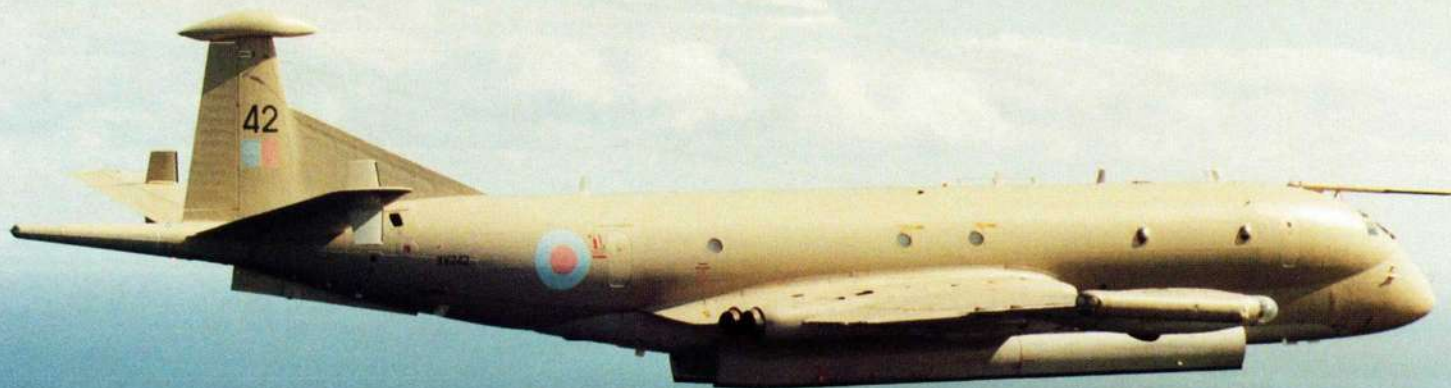
Recent complete paint stripping to bare metal at certain major overhauls has

The simulator control room in action at Kinloss. PRM



The Nimrod Major Servicing Unit conducting a major overhaul at Kinloss. PRM





Top and middle left: *Nimrods* are tasked with surveillance of the many drilling rigs and oil platforms in the North Sea, as well as SAR responsibilities. PRM Middle right: *Flight deck on the Nimrod* - typical of the 60s airliner. PRM Above: A *Nimrod MR2* receiving a washdown as it taxis in at Kinloss. RAF Kinloss

revealed up to 21 coats of paint as the hemp scheme was applied over the original grey and white scheme. The cost of the paint removal will be more than balanced by the reduced overall weight and consequent fuel saving. The NMSU is usually manned by approximately 200 RAF and 70 British Aerospace personnel.

Kinloss is ideally situated geographically in one of the best 'fine weather' regions of the UK which assists its role as a major operational airfield and a Master Emergency Diversion Airfield (MEDA) and acts as a host to aircraft from airfields which have been closed due to poor weather, including civilian airliners from nearby Inverness (Dalcross) Airport. It also receives visiting aircraft from within NATO, as it is a convenient base for the Tain and Rosehearty bombing ranges in the area. The approach radar of neighbouring RAF

Lossiemouth is used for airfield approach and departure control and local area surveillance. The wartime cross runways have been closed for some years, but the main runway, which is 7580ft long and 150ft wide is capable of handling any normal commitment. The northern taxiway has been upgraded and is now available as an emergency runway. Kinloss hosts three Joint Maritime Courses per year, working in conjunction with surface ships and other aircraft.

Despite the busy scene at this Scottish airfield, good relations are maintained with the local population, which is not easy with the powerful but noisy Spey engines. Difficult engine runs are carried out in the more remote parts of the airfield. Less than maximum power is used for take-offs by controlling engine thrust to suit the aircraft's operating all up weight.

The Station Commander is responsible for 2,500 base personnel controlling Administration, Operations, Engineering and Supplies Wings and Nos 120, 201 and 206 Squadrons. There are two gliding schools at Kinloss: the Fulmar Gliding Club operates various types of glider whilst No 663 Volunteer Glider School flies Slingsby Ventures. Moray Flying Club uses a Cessna 150. The RAF Mountain Rescue Unit continues to provide its invaluable assistance to the service and civilian populations. It is not surprising that the local economy of Nairn, Forres and Elgin is closely integrated and linked with this Royal Air Force base.

The Nimrod and its Scottish base at Kinloss have played a key role in maritime defence and air-sea rescue for some five decades and look set to continue in action through much of the 90s.

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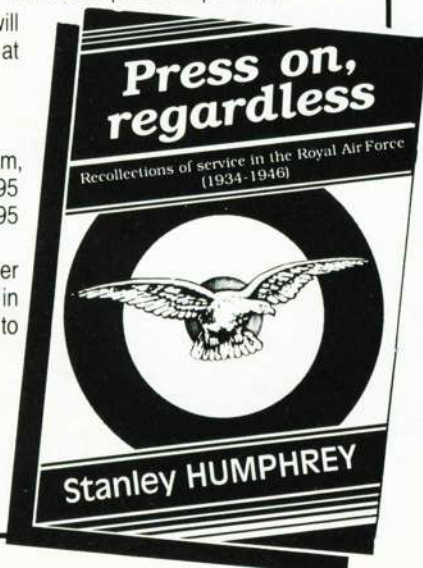
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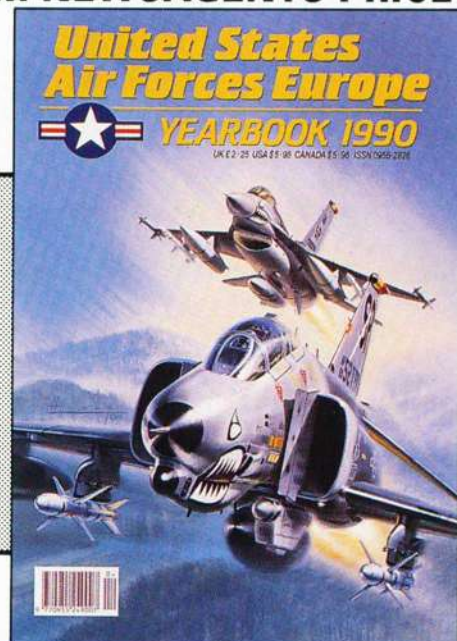
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LIFE IN THE OLD DOG

Paul A Jackson

Which RAF interceptor entered service before the now-retired Lightning, yet will remain in front line use for some years yet? The answer is not a manned aircraft — which most people immediately think of — but a missile which silently guards the approaches to Southern England every minute of every day. Like the faithful creature after which it is named, the Bloodhound SAM (Surface to Air Missile) stands prepared to track down any intruder encroaching upon its territory.

In the fast-changing world of aerospace, it has become fashionable to decry any system more than a few years old, the implication being that it is outdated and ineffective. 'Not so' say the men and women responsible for keeping the Bloodhound Force operational as an effective 'goalkeeper' to the fighter aircraft of No 11 Group, RAF Strike Command. Thanks to an ongoing programme of refurbishment and modernisation, the six East Coast flights of Bloodhounds remain the only truly instant, all-weather interceptor force in the RAF.

Deployment of the Bloodhound Mk1 began in 1958 at the culmination of a development process begun a decade earlier by the Bristol Aeroplane Co (now part of BAe) and Ferranti Ltd — the latter providing the radar guidance and control post. Bloodhound 1 was used to protect the V-bomber bases and was usually installed nearby. It had a range of 40 miles (64km), but its pulsed radar could be jammed and was vulnerable to ground 'clutter', thus degrading low-level capability. These shortcomings were quickly tackled, resulting in Bloodhound 2 joining the RAF in 1964.

Bloodhound was also stationed abroad, and in 1970 (after the Royal Navy had assumed the strategic deterrent role) all systems within the UK were withdrawn and either stored or transferred to RAF Germany, where No 25 Squadron had moved for aerodrome defence. Changing operational requirements later prompted a re-appraisal of this policy in the light of the low-level threat, resulting in No 85 Squadron forming at West Raynham, Norfolk, on 18 December 1975. Now the home of the Bloodhound Force, it had its first missiles operational with 'A' Flight and assigned to NATO on 1 July 1976.

New deployment plans called for the Bloodhounds to form a barrier, rather than a point defence system. Accordingly, March 1976 saw 'B' Flight form at North Coates, near Grimsby, whilst 'C' Flight was installed at Bawdsey (the historic site of the RAF's first radar station), near Ipswich, in July 1979. With the Thames—Humber line established, No 25 Squadron returned home from Germany between 1981 and 1983 to fill-in the gaps: 'A' Flight at Barkston Heath, Lincs; 'B' Flight and HQ at Wyton, near Huntingdon; and 'C' Flight at Wattisham, Suffolk. On 1 October 1989, No 25 Squadron became a Tornado interceptor unit at Leeming, and its bases were inherited by an expanded No 85 Squadron: D/85 at Barkston, E/85 at Wattisham and F/85 at Wyton.

Bloodhound remains in service simply because it is still an effective system. Once



Inside the Launch Control Post caravan, Pilot Officer Sally Hawkins (right) has one thumb on the launch button as a target comes within the Bloodhound's lethal range. Watching this training exercise is 'A' Flight's deputy commander, Sqn Ldr Alan Brooks.

dedicated to high-level interception, it has been switched to lower-altitude targets with little fuss other than mounting its radars on towers to give them an improved view. Radar energy (continuous wave, replacing the Mk 1's pulsed) reflected from the target is received by a dish antenna under the missile's nose-cone and the Bloodhound is directed towards the point in the sky at which the enemy aircraft will be intercepted. Changes in direction are achieved by moving the two wings in the centre of the missile body either differentially or in unison: the so-called 'twist and steer' principle.

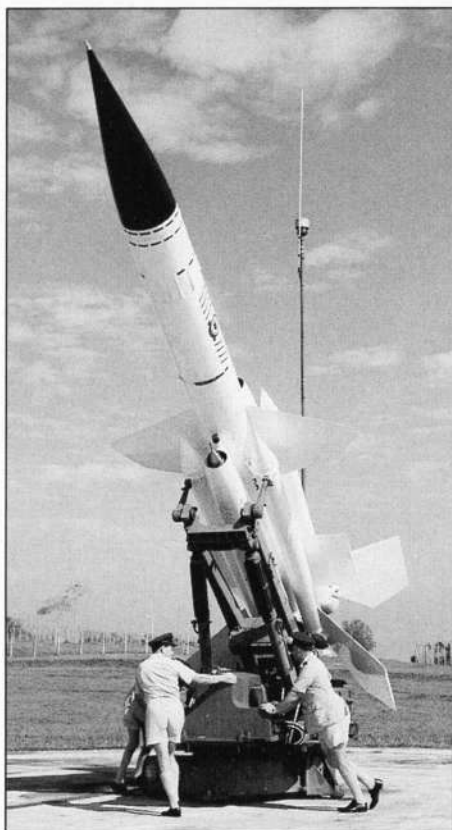
Sports car aficionados, to whom '0—60' times are of great interest, may care to contemplate the fact that on launching Bloodhound achieves 0 to 760 (1,220 km/h — the speed of sound) within the 25ft (7.62m) of its own length. Four seconds later, the four RoF Gosling solid-propellant boost rockets have accelerated the missile to Mach 2.5 and fallen away. By then, the two Bristol Thor liquid-fuel ramjets are working to sustain the SAM during a flight of up to 80 seconds.

Having been mounted on a ramp inclined at 34°30', the weapon will now probably be far above its quarry. Tipping over on its nose, it will dive on the victim, guided by the reflected radar energy still originating from its launch pad scanner. The manoeuvring tricks for making pulse-Doppler radar break its lock do not work for continuous wave, whilst attempting to jam the radar can be counter-productive unless done with great circumspection, as the Bloodhound has a 'home-on-jam' facility.

Detonated by a proximity fuse, the warhead explodes to scatter a shower of metal rods which form, effectively, a 120ft (37m) circular-saw spinning through the air. Precise details of range are secret, but published data refers to a radius of 50 miles (80 km) — the Mk2 carries more fuel and target heights up to 59,000ft (17,980m) and well below 1,000ft (305m).

The men and women who operate and service 'The Dog' come under the Bloodhound Force Commander (BFC), who is also the station commander at West Raynham. As the top link in the command chain, the BFC works in the Force Operations Room and is in direct contact with the Southern Sector Commander at Neatishead, the underground bunker which co-ordinates air defence forces south of the Humber. On the next rung down are the six Bloodhound Flights, each of between two and four Sections. A Section controls six to eight launchers and one radar from its Launch Control Post (LCP) caravan. A back-up stock of missiles is held close-by, ready to be bolted on to the launcher by a side-lifting vehicle.

Communication of orders and information between all levels of the command have been expedited by newly installed Auto Data Processing (ADP) system using Hewlett-Packard HP1000A hardware and BA-designed programmes. ADP extends down to the six operations rooms of the Bloodhound flights, the first to be so equipped commissioning late in 1987. Data presented on screen includes details of potential targets acquired, individual weapon readiness and engagement status. The Force Commander can therefore see



During the 1960s the Bloodhound was deployed in the Far East.

the whole tactical picture as a computer-generated map and also call up any one of over 100 pages of engineering status data on the Bloodhound force. If any site is put out of action, the others are quickly able to assume its functions.

LCPs have their own power generators and air conditioning — but the latter is for the benefit of the computers, not the staff! Here, the number-crunching is performed by a recently installed Ferranti Argus 700 computer which processes radar data and checks-out the serviceability of the Bloodhounds on their pads. Appropriate data is displayed on screens monitored by the officer or NCO Engagement Controller and his or her SNCO technical assistant.

The LCP is, from the outside, no more sophisticated than a caravan protected by an earth revetment. This is deceptive, for the caravans are just completing a refurbishment programme which includes a complete re-build with the new computer and consoles. Similarly, the Ferranti Type 86 Firelight I/J-band radar caravans are being gutted and stripped down to bare metal before renovation under a contract due to be completed by the middle of this year.

In the past, No 85 Squadron had the fixed-base Marconi Type 87 Scorpion and No 25 used air-portable Type 86s. For reasons of economy, the force has now standardised on the T86 — even though mobility is not required — because additional second-hand equipment of the same type was available from Sweden and the retired Thunderbird SAMs of the British Army. West Raynham went over to T86 in 1986 and was followed by the coastal stations of North Coates and Bawdsey in 1988. The other three bases, of course, have had that radar since establishment. Inland-based units have their radar on 30ft (9m) towers, but

coastal units use the 14ft (4m) base of the old T87 which, because of its shape, used to be known as a 'Dalek'.

It may seem curious, yet is entirely logical, that each Bloodhound missile section is treated like an aircraft — to the extent of having its own 'Form 700' which is handed to each Engagement Controller coming on duty. Every year, missiles receive a Minor Overhaul, and every two years undergo a more searching 'Major', this work being carried out at West Raynham's Missile Servicing Flight for all except the North Coates Bloodhounds (which have their own facility). Because the weapon is fuelled and armed when on the launcher, safety dictates that only minimal servicing can be accomplished in situ. If an 'on-line' signal fails to show on the missile status screen in the control post, the round has to be made safe before removal indoors for technical examination.

Electronic check-out equipment will find any fault in the circuit boards, but there ends the parallel with modern electronics. Instead of plugging in a new board and dispatching the old unit elsewhere for repair, as on a Tornado squadron, the Bloodhound technician plugs in his soldering iron. Throw-away technology has yet to reach No 85 Squadron, and the result is Servicing Flight staff who have the job-satisfaction of being able to follow a fault through from diagnosis to rectification with their own hands.

After 25 years of service, the Bloodhounds are now receiving a well-deserved refurbishment. Despite having been lashed by the elements for the greater proportion of this time, they have resisted well, although just to make sure, each is completely dismantled and stripped of paint. Other programmes have included overhaul of ramjets, nosecones and warheads, plus removal of aluminium covering from the wings to reveal the wooden core for a corrosion check. (The RAF could never live down reports of dry rot or woodworm infestation in its front-line equipment.) Missiles not immediately put back on launchers are kept in the external Ready-Use Missile Store, connected to a pipe which constantly passes dried air through their electronics.

Nearby, Bloodhound launchers supply the same service to ready-to-fire rounds from an air conditioning unit. Also part of the launcher are an electronic power supply and a hydraulic pack to rotate the launcher and power the missile's controls during the first few seconds of flight. Observers have attached great political significance to the fact that all Bloodhounds point East but, in fact, they are simply turned to have their backs to the prevailing (westerly) wind when not at readiness. Called to action, the six or eight weapons of an LCP rotate in unison to point where the Type 86 radar is looking.

Weapon, Airframe, Propulsion, Air Radar and Air Defence technicians pass to and from the Bloodhound Force during their service careers, just as if it were an aircraft-operating unit. Similarly, though volunteers to 'pilot' a Bloodhound in the accepted sense of the word are notoriously scarce, the closely-approximating Engagement Controllers were previously drawn mainly from the same General Duties (Air) Branch



Top left: The Ready-Use Missile Store contains re-load rounds which are constantly fed with dried air. Replacement is a matter of lowering the launcher to the horizontal position and installing a new round carried on a side-lifting vehicle. Above left: With covering panels removed, a Bloodhound is hooked-up to the Missile Overall Test Equipment (MOTE) for fault analysis. Checking the electronics is 22 year-old Junior Technician Paul Carter from Cleethorpes. Above right: 'Our warriors in serried ranks assembled' Never quaver (they conceal it if they do) — W.S. Gilbert, *The Mikado*. Like birds, the missiles stand with their backs to the prevailing wind — which just happens to mean that they point East. Paul Jackson photographs

of the Service. Now, almost all those responsible for launching Bloodhound are fighter controllers, to be augmented in the future by a few personnel from the RAF Regiment. Since 1980, women have been joining the ranks of Controllers, the first of them (Fit Lt Fiona Barnes) gaining the further distinction in November 1986 of becoming the first woman to launch a live Bloodhound for a random reliability test. (This, of course, was done at the Aberporth missile range in Cardigan Bay against a Jindivik drone.)

Every minute of the day, every day of the year, there is at least a nucleus of personnel ready for action at each Bloodhound site. The Engagement Controllers maintain proficiency by tracking the plentiful air traffic in eastern England or using the training facility which, with the simple change of a computer programme, turns the LCP caravan into a simulator. Controllers can practice against computer-generated targets, or more Posts can be plugged in to the command and control network to the point where the entire Bloodhound Force is participating in a single, synthetic exercise. When working up to proficiency, new Controllers are pitted against the Canberras of No 360 Squadron, which attempt to jam the radar. No 100 Squadron — another Canberra target facilities unit — makes mock attacks on missile sites for both training and calibration purposes.

At readiness, the Controller will be constantly searching the assigned Missile Engagement Zone (MEZ) for a hostile target. Not only will the definition of a 'hostile' vary according to the tactical situation, but the MEZ itself will also change in area. For example, one sector may be designated a no-fire zone to allow the safe recovery of friendly aircraft to a nearby aerodrome. In another scenario, all aircraft flying low and at high speed may be regarded as hostile and treated accordingly.

A second combat task will involve the

Bloodhound being given instructions to hit a specific target, anywhere within range, by the southern Sector Operations Centre at Neatishead — perhaps the survivor of fighter battle out at sea. Finally, if Neatishead so requires it, the Type 86 radar can be used to provide target information for RAF fighters to augment the dedicated radar chain. The opportunity to practice in a realistic situation occurs when No 11 Group, the whole of Strike Command or even a sizeable portion of NATO hold their regular air exercises in the Elder Forest and Elder Joust series.

Sitting in the dim light of the LCP caravan, the Controller will investigate targets until a hostile subject is found. This is presented on a computer-generated display which filters-out the distracting 'mush' of ground echoes. At the next console, the SNCO technician monitors the health of the missiles, his TV screen displaying a score of parameters for each of the six or eight under the LCP's jurisdiction. Meanwhile, the Controller is checking the signal-to-noise ratio to ensure that the Bloodhound will have a reflected signal strong enough to track. Given elevation and azimuth and range by radar, the computer uses trigonometry to calculate height. If parameters are within limits, 'FREE TO FIRE' is displayed in green on the screen.

When the launch button is pressed, the computer begins to check-out each of the Bloodhounds in turn. A fraction of a second later it will select the first missile found to be fully serviceable and send the launch signal through the two thick cables connecting each to the LCP. Initially, the missile and launcher are 'parented' via signals from the Type 86 radar received by the tall Stalk Aerial on the rear of the launcher. On firing of the four booster rockets, a total thrust of 100,000lb (45,360kg) — more than a Vulcan at full throttle — shears the bolts connecting

Bloodhound and launcher. When it is recalled that the missile itself weighs only 4,000lb (1,814kg), the reason for its rapid departure becomes obvious.

Close examination of the radar on its plinth reveals several antennae. There is the large dish-shaped transmitter and small 'orange peel' receiver, plus a small circular Jamming Assessment Aerial (the same as in the Bloodhound's nose) providing the Controller with a subsidiary picture. Nearby, looking like a segment of processed cheese, the In-Flight Reference Aerial sends the Bloodhound a simple of radar energy when it is at high altitude.

A moving target reflects the Type 86's radar energy at a slightly different frequency (the Doppler Effect). Because the receiver in the Bloodhound is also travelling through space, a further apparent shift in frequency is produced. The outcome of this process is predicted by the LCP's computer and the missile instructed to search for a signal of that type. The receiver dish inside its nosecone then turns to lock on to the target, whilst the Bloodhound itself points towards the anticipated point of collision. (In other words, the dish does not point straight ahead except in the rare case of a tail-chase.) The master video screen in the LCP includes a clock count-down to interception time, and if the reflected signal display disappears as this reaches zero, there is no need for the Controller to put his/her head outside to listen for the bang.

If that all sounds very simple. . . it is. That is why the Bloodhound will be around for some years to come, for those who sing the praises of everything new and sophisticated tend to forget it is not only the occasional human who can be described as 'too clever for his own good'. Though straightforward — even primitive in some areas — 'The Dog' is still capable of giving a fatal bite to those who trespass on its domain.



THE RAF'S YEAR 1989

Brian Strickland reviews some of the RAF's highlights of 1989

JANUARY

Several hundred airmen continued to take part in the rescue and salvage operation following the crash of the **PanAm Boeing 747** with the loss of 270 lives near **Lockerbie** on 21 December 1988.

On 8 January three helicopters ferried survivors to hospital after a **British Midland Airways Boeing 737-400** crashed on the M1 motorway near **Kegworth** in Leicestershire with the loss of 44 lives. One Sea King from Leconfield, another from Brawdy and a Wessex from Coltishall were quickly on the scene. RAF Mountain Rescue teams from Stafford and Leeming helped survivors from the wreckage.

Sqn Ldr Frank Waddington, a pilot with No 27 Squadron at Marham gained 5000hr having flown only two types of operational aircraft, the Buccaneer and Tornado, since completing his flying training.

The 50th anniversary of the formation of the **Auxiliary Air Force Reserve** was marked on 17 January. It was formed to enable ex-airmen of the AAF to serve with the Auxiliary flying squadrons in an emergency.

On 16 January **Air Commodore Tim Elworthy** took over as the new Captain of the Queen's Flight at Benson.

Master Air Loadmaster 'Smokey' Furness completed his last sortie as winchman having achieved 2800hr SAR flying in more than 330 operational sorties.

FEBRUARY

On 1 February **HM The Queen Mother**, Honorary Air Commodore of **No 55 Squadron** since 1976, visited Marham to unveil a plaque commemorating the official opening of the relocated office accommodation and crew rooms of the Squadron.

The RAF College Cranwell basic flying school was given the title **No 3 Flying Training School** on 1 February.

With the introduction into service of the UK's **SKYNET 4B** military communications satellite, which had been launched by Ariane IV rocket, the RAF's new 'Space Squadron' successfully completed its first operational task.

The Queen Mother laid a wreath in the RAF Chapel at **Westminster Abbey** to dedicate a memorial to leaders of the Royal Air Forces of Great Britain and the Commonwealth in WW2.

An **RAF Harrier GR5** from No 233 OCU at Wittering together with a **Tucano** provided outstanding displays at the first Air Show, modelled on Farnborough, to be staged by the United Arab Emirates at **Dubai**. No 101 Squadron from Brize Norton provided an air-to-air refuelling for the Harrier along the route and staged through Akrotiri, Cyprus.

Top: *The Queen Mother visited Scampton in July to congratulate the Red Arrows on 25 years of display flying.* RAF Scampton Below: *The Harrier GR7 first flew at Dunsfold on 29 November.* BAe



The first operational Cruise Missile Wing at **Molesworth** closed under the terms of the Intermediate range Nuclear Forces Treaty of December 1987. The massive bunkers were cleared of the 16 ground launched cruise missiles.

On 23 February the development prototype of a batch of 12 replica aircraft was installed on a plinth at **Biggin Hill**. Carrying the markings of No 92 Squadron, the most famous of Biggin Hill's Battle of Britain squadrons, **Spitfire N3194** occupies pride of place outside the St George's Chapel of Remembrance. This was the first glassfibre aircraft to be installed as part of the new policy to rescue its historic aircraft from outside display. Real aircraft will now be displayed under cover and durable replicas will be used as external gate guardians. A replica **Hurricane** in No 79 Squadron markings subsequently joined the Spitfire.

MARCH

Sqn Ldr Bob Henderson, currently a Tristar captain on No 216 Squadron, notched up 15,000 flying hours whilst crossing the Atlantic.



Tristar No 216 Squadron. PRM

The BAe 125s of **No 32 Squadron** at Northolt were adapted to accommodate an incubator so as to provide, in addition to its normal tasks, a new mini RAF aeromedical service. This now enables seriously ill babies from Germany, Gibraltar and Cyprus to be quickly flown to the UK for specialist treatment. Aircrew are on permanent standby together with an aeromedical team at Wroughton hospital.

On 9 March five **Shackletons** (of six remaining in RAF service) from **No 8 Squadron** flew from Lossiemouth to Woodford, where 180 Shackletons were built by Avro for the RAF, to celebrate the type's 40th birthday.

18 March saw the last Hercules Airbridge sortie from **Lyneham** to the Falklands. Since 1982 a total of 650 flights, each involving a round trip of 14,600 miles and 30 hours of flying have taken place. The task has now been taken over by **No 216 Squadron** at Brize Norton.

APRIL

On 1 April **Kinloss** celebrated its 50th birthday. The Scottish airfield was originally opened as No 19 OTU for the training of crews for Bomber Command during WW2.

Fit Lt Taylor Devlin achieved his 1000th air-to-air refuelling contact in a Nimrod MR2 flying from Kinloss.



Fit Lt Taylor Devlin at the controls of a Nimrod MR2. PRM

On 27 April **Sqn Ldr Paul Burnside** of No 11 Squadron at Leeming became the first RAF pilot to have flown 1000hr in the air defence version of the Tornado.



Tornado F3 No 11 Squadron. PRM

MAY

The 75th anniversary of the formation of **No 7 Squadron** at Farnborough was marked on 1 May. No 7 was the last of the RFC squadrons to be formed before WW1. Today it operates Chinook HC1s from nearby RAF Odiham.

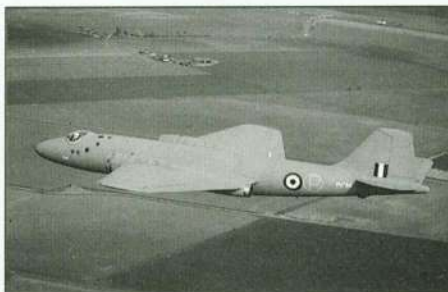
Wing Commander Dave Pollington, OC No 92 Squadron at Wildenrath became the first RAF pilot to complete 4000hr on the Phantom.

A service of Thanksgiving was held at St Pauls Cathedral to celebrate the formation of the **Women's Auxiliary Air Force** 50 years ago.

A Tail Dock was opened at **Brize Norton** (70ft high, 83ft wide and 45ft deep) to allow major servicing of Tristars of No 216 Squadron.

8 May marked the 10th anniversary of the signing of the Memorandum of Understanding between Great Britain, the Federal Republic of Germany and the Republic of Italy which established the **Tri-national Tornado Training Establishment** at Cottesmore.

The 40th anniversary of the first flight of the **English Electric Canberra** was celebrated at RAF Wyton on 13 May. It is the home base for the four units operating the RAF's remaining examples. A line-up of 40 Canberras was assembled. A T4 was painted in the blue colour scheme of the first prototype.



The prototype Canberra was represented at Wyton by this blue painted T4. T. Malcolm English

JUNE

Chivenor received its 100th fighter training course since re-opening in 1980. No 2 Tactical Weapons Unit has so far trained 1,390 students.

Fit Lt Norman Rose RAFVR(T) of No 10 AEF at Woodvale retired at 65 after a record 47 years of continuous flying totalling 11,538hr.

The Reverend Fit Lt Jackie Petrie made service history when she became the first woman minister to be commissioned as a chaplain in any of the three services.

No 236 OCU won the **Aird-Whyte Trophy**, an anti-submarine competition where speed of location and accuracy of attack on the target is paramount.

HM The Queen presented colours to the **Royal Auxiliary Air Force at Benson** on 12 June. It was the first reserve force of the Armed Services to receive such an award. Formed in 1925, the AAF received the Royal prefix in 1947. Its Flying Squadrons were disbanded in 1957.

JULY

The 50th anniversary of the formation of the **Women's Auxiliary Air Force**, for duty with the RAF in wartime, was celebrated on 1 July.

The roll-out of the first **Boeing E-3D Sentry AEW1** for the RAF took place. The aircraft is the first of seven ordered for the AEW role in the RAF and is due to be delivered to No 8 Squadron at Waddington in March 1991.

The Queen Mother visited **Scampton** to congratulate the Red Arrows on 25 years as the RAF Aerobatic Display Team.

The first replica **Hurricane, V7467/LE-D**, was unveiled at **Coltishall**, bearing the colour scheme of the aircraft used by Douglas Bader whilst commanding No 242 Squadron during the Battle of Britain.

On 6 July the last **Jet Provost T4s** in service with the RAF were retired from the CATCS at RAF Shawbury.

Col General of Aviation A F Borsuk, Deputy CinC (Combat Training) Soviet Air Forces visited **RAF Leuchars** to see Tornado GR1 and F3 aircraft.

During a four-day detachment to Valley the new Harrier GR5s of No 1 Squadron at Wittering carried out the first live **AIM-9 Sidewinder** firings by operational squadron aircraft.

It was confirmed on 20 July that for the first time since the RAF was formed on 1 April 1918, **women** are to be recruited to the service as pilots and navigators.

AUGUST

No 2 Squadron at **RAF Laarbruch** completed its conversion from Jaguar GR1A to Tornado GR1A aircraft to continue the reconnaissance task in RAF Germany.

RAF Staxton Wold in North Yorkshire, the world's oldest operational radar site, celebrated its half century with an open day.

14 August saw the first group of **female aircrew** applicants attend the Biggin Hill Officer and Aircrew Selection Centre.

Following the **Marchioness** disaster on the River Thames on 20 August three RAF helicopters helped to search the river for survivors. Two Sea Kings from C Flight, No 202 Squadron at Manston used their lights to search for people in the water. Later a Wessex from E Flight at Coltishall helped with the continued search.

Air Chief Marshal Sir Peter Harding, Chief of Air Staff, together with his wife and daughter, parachuted into the English Channel from a Hercules of No 47 Squadron to launch the RAF Benevolent Fund's **Battle of Britain Anniversary Appeal**.

25 August marked the 75th anniversary of the first enemy aircraft to be brought down by three aircraft of **No 2 Squadron, RFC**.

SEPTEMBER

The RAF saluted its USAAF allies in the Arnhem airborne assault 45 years previously when a Tornado of the TTTE at Cottesmore (flown by **Station Commander Gp Capt Ronald Elder**) overflew a preserved Douglas C-47 Dakota at the Imperial War Museum, Duxford. Not only had this very Dakota flown at least two missions to Arnhem, but it also did so from Cottesmore, which was then home to the USAAF's 316th Troop Carrier Group.

On Sennelager military training area in Germany, the Harrier GR5 made its first field deployment on the Continent in the hands of newly-equipped **No 3 Squadron** from Gütersloh.



Harrier GR5s on deployment in Germany. Paul Jackson

1 September marked the **50th anniversary** of the complete mobilisation of the Royal Air Force, with legislation for extension of military service to all physically fit men between the ages of 18 and 41.

The first of the new female aircrew students commenced training to be navigators with **No 6 FTS** at Finningley.

A Hercules from Belize flew relief supplies to Antigua and Monserrat following the devastation caused by **Hurricane Hugo**. It flew 24 sorties in two weeks, airlifting 500,000lb of freight and 400 personnel.

One of the world's largest military hangars was opened at **Waddington**. It will be used to service the RAF's new Boeing E-3D Sentry AWACS aircraft.

OCTOBER

Exercise 'Elder Joust' was held between 3 and 5 October, testing the effectiveness of No 11 Group's interceptors, SAMs and radar sites as Britain was 'raided' by RAF and allied aircraft from the continent. Phantoms, Tornado F3s and Hawks were scrambled to meet the raids. Over 900 low-level sorties were flown during daylight during this exercise, which was the largest UK air defence exercise of the year in which seven NATO air forces participated.

Smoking was banned on all **RAF VC10** and **Tristar** flights of up to 3 hours duration following a trial on aircraft chartered from Britannia Airways.

No 54, a new Squadron of the **RAF Regiment**, equipped with the **BAe Rapier** surface-to-air missile system for defence against low-flying aircraft, was formed at RAF Leeming where three Tornado F3 squadrons are based.

RAF St Mawgan hosted the **Fincastle Trophy** for maritime reconnaissance aircraft from Australia, Canada, New Zealand and the UK between 23 and 30 October. The trophy, presented in memory of Sgt Nairn Fincastle Aird-Whyte, killed in action with Coastal Command in 1943, was won by a CP-140 Aurora of No 415 Squadron, Canadian Forces from Greenwood, Nova Scotia.

It was announced that a third BAe 146-100 was to be purchased and delivered in 1990 for the **Queen's Flight**, replacing the remaining Andover.

4 October saw a special international air show at **RAF Scampton** to celebrate the 25th anniversary of the formation of the RAF aerobatic team. Five other teams from France, Portugal, Switzerland, Italy and Spain helped celebrate the Silver Jubilee of the **Red Arrows**.



European aerobatic teams assembled at RAF Scampton to salute the Red Arrows. Paul Jackson

The Aberporth Trophy, which is awarded to the RAF Air Defence Squadron with the best live missile firings over the year, was presented to No 92 Squadron at Wildenrath.

The crew of Hercules XV203 from No 1312 Flt at **RAF Mount Pleasant** clocked up a combined 10,000 hours on type on 31 October.

NOVEMBER

No 13 Squadron at Honington, the latest Tornado GR1 squadron to form, received its first aircraft. This is the second Tornado squadron dedicated to the reconnaissance role and is the last of the eleven front-line squadrons to receive Tornado GR1s under present plans.

A spectacular tribute by the Queen's Colour Squadron of the RAF Regiment was the highlight of the RAF's participation in the **Festival of Remembrance** at the Royal Albert Hall.

The **BAe Harrier II GR7** night-attack aircraft made its maiden flight at Dunsfold on 29 November. A further 34 GR7s are on order.

DECEMBER

The first major deployment of the **Harrier GR5** took place when a Harrier from Germany flew to Cyprus for combat training with Phantoms from Nos 19 and 92 Squadrons.

An unprecedented group of rescuers and rescued gathered at **Lossiemouth** on 15 December to preview the 13-part Scottish TV documentary 'Rescue' shortly before it was broadcast nationally on ITV. For a year a TV team had lived in a caravan beside the headquarters of D Flight, No 202 Squadron at Lossiemouth, accompanying every call out including the horrific **Piper Alpha** oil platform disaster. Principal amongst the unintentional stars of the series was premature baby Sam Marcus, whose life was saved by a Sea King flight from Orkney to Aberdeen hospital.

At **RAF Church Fenton** No 42 Basic Flying Course, the first to be trained on the new Tucano T1 trainer, commenced formal flying instruction.

On 15 December the **RAF Gliding and Soaring Association** celebrated its 40th anniversary. There are currently eleven clubs in the Association. The original aim of the RAFGSA was, and still is, 'to bring gliding and soaring within reach of all RAF personnel, with special regard to those normally employed on the ground'.

No 25 Squadron became fully operational at midnight on 31 December and was declared to NATO. Thus, with Nos 11 and 23 Squadrons, Leeming's Tornado Air Defence Wing was complete.



The first course on the new Tucano T1 commenced at Church Fenton in December. PRM



CP-140 Aurora of No 415 Sqn, Canadian Forces won the Fincastle trophy at RAF St Mawgan in October. PRM



The RAF Gliding and Soaring Association celebrated its 40th anniversary in December. PRM

RAF On Display 1990

Peter R. March



Above: No 228 OCU Phantom crew Fit Lt Steve Howard (right) and Fit Lt Nige Marks, navigator. RAF Leuchars

The Royal Air Force will be on display to the public at many of its stations, at air shows up and down the country and at fetes, exhibitions and seaside resorts from May to the end of September.

The RAF Aerobatic Team the **Red Arrows** led by Squadron Leader Tim Miller for the third year, has a very full programme of over 100 performances planned, commencing on 6 May and running through to the end of September. The team will be taking part in the huge 163 aircraft flypast over London on Saturday 15 September, to mark the Battle of Britain anniversary. Needless to say the Spitfires, Hurricanes and Lancaster of the Battle of Britain Memorial Flight will also be in great demand.

Many of the RAF and civilian air shows are adopting the 50th anniversary as their special themes. Undoubtedly the biggest of these will be the **Battle of Britain Air Show** at the A&EE Boscombe Down on 9-10 June, when it is planned to have up to 20 Spitfires and Hurricanes as a feature of the display. Another historic RAF aircraft flying at air shows this year is the Vulcan B2. Sadly this seems likely to be the last year that Fit Lt Paul Millikin and Sqn Ldr David Thomas will be putting the delta bomber through its paces, unless the appeal by the Vulcan Association is successful in raising sufficient funds to keep it flying.

The RAF's front-line aircraft will also be much in evidence on the air show scene. At the time of going to press the following aircraft and crews are expected to be on display:

Tornado F3 — No 229 OCU, Coningsby. Fit Lt Fred Grundy (in his third season) with Fit Lt Martin Parker as navigator. Fred will be flying specially painted Tornado F3 ZE907.

Phantom FGR2 — No 228 OCU, Leuchars. Fit Lt Steve Howard with Fit Lt Nige Marks as navigator.

Hawk T1A — No 234 Squadron/1 TWU, Brawdy, Fit Lt John Carter.

Harrier GR5 — No 233 OCU, Wittering, Fit Lt Nick Gilchrist.

Tornado GR1 — TWCU, Honington, Fit Lt R S Pearson and Fit Lt D E M Reid; No 27 Squadron, Marham, Fit Lt Steve Hillier.

Puma HC1 — No 240 OCU, Odiham, Fit Lt Jerry Smith; No 33 Squadron, Odiham, Fit Lt Ges Charlton.

Chinook HC1 — No 240 OCU, Odiham, Fit Lt P M Ward; No 7 Squadron, Odiham, Fit Lt T S Milburn.

Hercules — No 242 OCU, Lyneham, Fit Lt W A Ferrol and Fit Lt K J Baggley.

Nimrod MR2 — No 120 Squadron, Fit Lt Steve Smith; No 201 Squadron, Fit Lt Al Hughes; No 206 Squadron, Fit Lt Chris Birks — all at Kinloss and No 42 Squadron, Fit Lt Mark Seymour at St Mawgan.

Buccaneer S2 — No 237 OCU, Lossiemouth. Fit Lt Ian Baston with USAF exchange officer Captain Andy La Mar (navigator).

Canberra — No 100 Squadron, Wyton, Fit Lt Dave Piper.

Wessex — SARTU, Valley, Fit Lt K W Park, 'E' Fit No 22 Squadron, Coltishall, Fit Lt R Jackson.

Sea King HAR3 — 'A' Fit No 202 Squadron, Boulmer, Fit Lt J D Neighbour; 'E' Fit No 202 Squadron, Leconfield, Fit Lt M. J. Counter.

RAF Support Command will also have a number of solo display aircraft appearing alongside the Red Arrows. Hawk T1, Jet Provost, Tucano and Bulldog display pilots will be designated after the annual flying competitions amongst QFIs take place in April and early May.



Display pilot Fit Lt Fred Grundy (right) and navigator Fit Lt Martin Parker with their specially painted Tornado F3. Brian Strickland





The Red Arrows will perform over 100 displays in 1990. PRM



Spitfires (like this Battle of Britain Memorial Flight PR19) and Hurricanes will be much in demand this anniversary year. PRM



Solo Hawk display aircraft 1989. John Dunnell



Vulcan B2 XH558 — Vulcan Display Flight. PRM

No 1 FTS solo Jet Provost T3A in 1989. PRM



The list below details many of the RAF stations and other air shows around the UK that are expecting to hold open days and other events at which RAF aircraft are expected to be giving displays. This list is PROVISIONAL at the time of going to press. Readers should check with organisers that any event listed that they plan to attend is taking place on the date and at the venue shown. Where an asterisk is shown after the name of an event it is expected that the **Red Arrows** will be displaying.

May

- 6 **RAF Upper Heyford, Oxon:** USAF Open House [*]
- 6 **Old Warden, Beds:** Shuttleworth's Airborne Pageant
- 12-13 **North Weald, Essex:** Fighter Meet 1990 [*]
- 20 **RAF Cranwell, Lincs:** RAF College Air Day [*]
- 26-27 **RAF Mildenhall, Suffolk:** USAF Air Fete '90 [*]
- 28 **Southend, Essex:** Southend-on-Sea Air Show [*]

June

- 2 **RAF Henlow, Beds:** RAF Open Day
- 3 **RAF Hereford, Hereford & Worcs:** RAF Hereford Open Day [*]
- 9 **RAF Buchan, Grampian:** RAF Buchan Gala Day
- 9-10 **A&EE Boscombe Down, Wilts:** RAF Battle of Britain Air Show [*]
- 10 **RAF Church Fenton, N. Yorks:** SSAFA Air Display [*]
- 10 **RAF Cosford, West Midlands:** Cosford Air Show [*]
- 16 **RAF Coningsby, Lincs:** RAF Coningsby Open Day
- 16 **RAF Halton, Bucks:** RAF Halton Show
- 16-17 **Biggin Hill, Kent:** International Air Fair
- 17 **RAF Swanton Morley, Norfolk:** RAF Swanton Morley Air Show
- 23 **RAF Locking, Avon:** RAF Locking Flowerdown Fair
- 23 **Woodford, Cheshire:** RAFA/BAe Air Show

July

- 1 **Old Warden, Beds:** Shuttleworth Military Air Pageant [*]
- 7-8 **RAF Chicksands, Beds:** USAF Open Days
- 8 **Duxford, Cambs:** Classic Fighter Show
- 8 **RAF Cosford, West Midlands:** Aerospace Museum Air Pageant [*]
- 8 **Wroughton, Wilts:** 50th Anniversary Air Display
- 14 **RAF Benson, Oxon:** RAF Open Day [*]



Jaguar GR1A of No 41(F) Sqn over the 1989 Mildenhall Air Fete. No 41(F) Squadron

- 14 **RAF Cottesmore, Leics:** RAF Families Day [*]
- 14-15 **New Brighton, Cheshire:** Wirral Air Show
- 15 **RAF Manston, Kent:** RAF Open Day [*]
- 21 **Newtownards, Co. Down, NI:** Ulster Air Show
- 21-22 **AAC Centre Middle Wallop, Hants:** International Air Show 90 [*]
- 22 **Badminton, Avon:** Badminton Air Day
- 22 **Humberside, E. Yorks:** Eastern International Air Fair [*]
- 25 **RAF Chivenor, Devon:** RAF Open Day [*]
- 26 **Weston-super-Mare, Avon:** Great Weston Air Day [*]
- 26 **RAF Brawdy, Dyfed:** RAF Open Day [*]
- 28 **RAF Wittering, Cambs:** RAF Open Day

August

- 4-5 **RAF Lakenheath, Suffolk:** USAF Open Days
- 5 **Old Warden, Beds:** Battle over Britain Flying Display
- 5 **RAF Swinderby, Lincs:** 50th Anniversary Open Day
- 8 **RAF St Mawgan, Cornwall:** International Air Show [*]
- 12 **Jurby, Isle of Man:** RAFA Air Display
- 12 **RAF Alconbury, Cambs:** USAF Open Day [*]

- 26 **Leicester Airport:** International Air Display [*]
- 27 **Staverton, Glos:** Staverton Air Show [*]
- 27 **West Malling, Kent:** Great Warbirds Air Show [*]

September

- 6-9 **Farnborough, Hants:** Farnborough International 90 [*]
- 9 **Folkestone, Kent:** Shepway Battle of Britain Festival Air Display
- 13 **Guernsey, Channel Islands:** Battle of Britain Air Show [*]
- 13 **Jersey, Channel Islands:** Battle of Britain Air Show [*]
- 15 **London:** RAF Battle of Britain 50th Anniversary Flypast [*]
- 15 **RAF Abingdon, Oxon:** RAF Battle of Britain At Home Day [*]
- 15 **RAF St Athan, S. Glam:** RAF Battle of Britain At Home Day [*]
- 16 **Duxford, Cambs:** Duxford '90 Air Display [*]
- 16 **RAF Newton, Notts:** RAF Newton Families Day [*]
- 22 **RAF Finningley, Yorks:** RAF Battle of Britain At Home Day [*]
- 22 **RAF Leuchars, Fife:** RAF Battle of Britain At Home Day [*]
- 23 **Cranfield, Beds:** Cranfield International Air Fair
- 30 **Redhill, Surrey:** Redhill Flying Display

Summer seaside air shows at coastal airfields like RAF Chivenor (25 July 1990) are popular with holidaymakers and residents alike. PRM





Sue J Bushell reviews the principal airfields and operational flying units of the Royal Air Force in 1990.



HOME & AWAY

ABINGDON, Oxfordshire (RAF)

RAF Abingdon was opened in 1932 and during WW2 operated Whitleys. For much of the post-war years it housed elements of Transport Command. Today it is the home for the Bulldogs of the London and Oxford University Squadrons (UAS) and the Chipmunks of No 6 Air Experience Flight (AEF). Abingdon also houses a maintenance unit where the RAF's Jaguars, Buccaneers and Hawks are serviced.

AKROTIRI, Cyprus (RAF)

The Mediterranean base for the Wessex HU5Cs of No 84 Squadron provides search and rescue cover. Akrotiri is used throughout the year by UK and Germany-based squadrons for Armament Practice Camps.

ALDERGROVE, Ulster

First opened in 1918 for just one year, Aldergrove fully re-opened in 1925. Today it houses the Wessex HC2s of No 72 Squadron as well as the Army Air Corps' No 665 Squadron (with Lynx and Gazelle helicopters) and the Islanders of No 1 Flight, Northern Ireland Regiment.

ARBROATH, Tayside (RN/RAF)

Opened on 19 June 1940, Arbroath was a Fleet Air Arm base, being used by the Air Engineering School from 1945 until 1970, when it was handed over to the Royal Marines. It is presently home to No 662 Volunteer Gliding School (VGS), with Grob Viking T1 gliders.

BARKSTON HEATH, Lincolnshire (RAF)

Barkston Heath was originally a Bomber Command airfield opened in April 1941 but saw USAAF presence during 1944—45. After WW2 it became a satellite of Cranwell and today provides a relief landing ground for No 3 Flying Training School as well as housing 'D' Flight of No 85 Squadron, equipped with Bloodhound II Surface-to-Air Missiles (SAMs).

BAWDSEY, Suffolk (RAF)

The RAF's first radar station, Bawdsey is home for 'C' Flight of No 85 Squadron with Bloodhound II SAMs.

BEDFORD, Bedfordshire (MoD PE)

Bedford/Thurleigh is now home to part of the Royal Aerospace Establishment. A large variety of aircraft are operated for test and evaluation duties, ranging from the elderly Vickers Viscount and Canberra to the Hawk T1.

BELIZE CITY, Belize

Formerly British Honduras (Central America), Belize International Airport hosts two RAF flights, namely No 1417 Flight, equipped with Harrier GR3s, and No 1563 Flight with Puma HC1s.

BENSON, Oxfordshire (RAF)

During WW2 Benson accommodated the Photographic Reconnaissance Unit. On 1 May 1946 it became the permanent home of the King's (now Queen's) Flight, which operates two Wessex HCC4s, two BAe 146s and one HS Andover. Also resident at Benson are the Andover E3s of No 115 Squadron, which calibrates navigation aids, the Andover Training Flight, the BAe 146 element of No 241 Operational Conversion Unit and the Venture T2s of No 612 VGS.

BISHOPS COURT, County Down (RAF)

Bishops Court was opened on 1 April 1943 to train observers. It was also used by Coastal Command during WW2. Today Bishops Court houses the Venture T2s of No 664 VGS and occasionally receives aircraft in connection with a nearby radar site.

BOSCOMBE DOWN, Wiltshire (MoD PE)

First opened in 1917 (but closed between 1920—27) Boscombe Down today has the Aeroplane and Armament Experimental Establishment (arrived in September 1939) and the Empire Test Pilots' School (from January 1968) in residence. The A&AE tests all new aircraft for the three services. Another based unit is the Strike/Attack Operational Evaluation Unit flying Tornado GR1s and Harrier GR5s.

BOULMER, Northumberland (RAF)

Situated near Alnwick, RAF Boulmer was opened in March 1943 as a satellite of Eshott, itself a training airfield. During the 1960s it was used as a relief landing ground by Acklington but today the Sea King HAR3s of 'A' Flight, No 202 Squadron are based for SAR duties.

Above (top): Jaguars on overhaul at Abingdon. PRM Above (right): The Empire Test Pilots' School at Boscombe Down operates this Jaguar T2A. PRM Below: Tornado GR1 operated by the RAE's Flight Systems Section at Bedford. PRM



BRAWDY, Dyfed (RAF)

Brawdy was opened during WW2 as an RAF base but was transferred to the Fleet Air Arm in 1946, remaining as such until 1974, when it became home to No 229 OCU. The unit was later renamed No 1 Tactical Weapons Unit (TWU) and continues at Brawdy today with Hawk T1As. No 1 TWU is split into two squadrons, each with a 'shadow' number — Nos 79 and 234 Sqns. Brawdy also has a search and rescue role with the Sea King HAR3s of 'B' Flight, No 202 Squadron.

BRIZE NORTON, Oxfordshire (RAF)

The largest RAF airfield in the United Kingdom, Brize Norton was originally opened in 1937. During WW2 it was used for airborne forces training and housed No 6 Maintenance Unit. It was passed to the United States Air Force for 15 years from 1950 but was handed back to the RAF in 1965. Today it houses two squadrons of VC10 aircraft — No 10 Squadron with C1 transports and No 101 Squadron, which operates K2s and K3s for air-to-air refuelling. Brize Norton also houses the TriStars of No 216 Squadron while No 241 OCU conducts TriStar and VC10 training here.

BRUGGEN, West Germany (RAF)

RAF Bruggen opened in 1953. Today it houses four Tornado GR1 strike/attack squadrons (Nos 9, 14, 17 and 31 Squadrons) and No 431 Maintenance Unit.

CATTERICK, Yorkshire (RAF)

Catterick was opened in 1915 and retained after WW1, becoming a fighter station during WW2. In 1945 it became the home of the Headquarters of the RAF Regiment. Catterick also has one flying unit, No 645 VGS, which operates Grob Viking T1 gliders.

CHIVENOR, Devon (RAF)

Situated near Barnstaple, Chivenor started as a civilian airfield but was taken over during WW2 by the RAF for use by Coastal Command. After the war it was passed to Fighter Command and was responsible for Hunter training until it closed in 1974. Chivenor reopened in 1980 as the home of No 2 Tactical Weapons Unit which is split into two squadrons — Nos 63 and 151, both operating Hawk T1As. Additionally, the Wessex HC2s of 'A' Flight, No 22 Squadron and the Venture T2 powered gliders of No 624 VGS are based here.

A Hawk T1A of No 63 Squadron, 2 TWU taking off from Chivenor. PRM



Coningsby based Devon used by the Battle of Britain Memorial Flight. PRM



CHURCH FENTON, Yorkshire (RAF)

Although its original role was that of fighter protection for the industrial northern area of North Yorkshire, Church Fenton became involved in training future pilots in 1959 and, apart from a four-year gap 1975—79, has continued with this role ever since. It is home to No 7 Flying Training School (FTS), which operated Jet Provost T3As and T5As but has now become the first FTS to convert to Tucano T1s.

COLTISHALL, Norfolk (RAF)

Originally opened in 1940, Coltishall has continued as a major fighter base, operating Mosquitoes, Spitfires, Vampires, Venom, Javelins and Lightnings. Jaguars replaced the Lightnings in 1974 and today three squadrons operate the type — Nos 6, 41 and 54 Squadrons. Also present are Wessex HC2s of 'E' Flight, No 22 Squadron for search and rescue.

CONINGSBY, Lincolnshire (RAF)

Previously the RAF's main UK Phantom base but now committed to Tornado F3 operations, Coningsby spent the first 25 years after opening in 1940, as a bomber station. It was the first base to operate the air defence variant of the Tornado and today houses No 229 Operational Conversion Unit. Also based at Coningsby are Nos 5 and 29 Squadrons, also operating the Tornado F3, as well as the F3 Operational Evaluation Unit. The aircraft of the Battle of Britain Memorial Flight are based here.

COSFORD, Shropshire (RAF)

Cosford has for many years been engaged in training of ground tradesmen at No 2 School of Technical Training. Flying units operating here include Birmingham UAS with Bulldog T1s and No 633 VGS, which flies Venture T2s. Cosford also houses the Aerospace Museum with its notable collection of historic aircraft.

COTTESMORE, Leicestershire (RAF)

Cottesmore opened in 1938 as part of the RAF's pre-war expansion programme. It was handed over to the USAAF in 1943 for the remainder of WW2 but eventually returned to the RAF to house part of the V-bomber force. It closed in 1976 but was reopened two years later for reconstruction work, enabling it to become the home of the Tri-National Tornado Training Establishment (TTTE), which moved in on 1 July 1980. This unit is engaged in training West German, Italian and British aircrew for the Tornado.

CRANWELL, Lincolnshire (RAF)

Cranwell has been an airfield since 1915 and became the home of the Royal Air Force College in 1920. Frank Whittle's Gloster E28/39 made its maiden flight from Cranwell in May 1941. Today it houses a fleet of Jet Provosts operated by No 3 Flying Training School for the RAF College.

FARNBOROUGH, Hampshire (MoD PE)

The original birthplace of British aviation, Farnborough has remained at the forefront of aviation endeavour ever since. Today it houses part of the Royal Aerospace Establishment with a selection of aircraft types, and the Institute of Aviation Medicine, which operates a single Jaguar T2.

FINNINGLEY, Yorkshire (RAF)

Located near Doncaster, Finningley was built as part of the RAF pre-war expansion programme and opened in 1936 as a bomber base. Today it houses No 6 FTS operating the Jetstream — for pilot twin-engine conversion; the Jet Provost and the Dominie T1 — for the training of navigators, air engineers and air electronics officers. Also resident at Finningley is the headquarters for Nos 22 and 202 Squadrons. Yorkshire UAS is also resident, flying Bulldogs; while No 9 AEF operates Chipmunk T10s from here.

GATOW, West Germany

The RAF has maintained a presence in Berlin since the end of WW2, principally at Gatow. The airfield was used during the Berlin Airlift of 1948—49. The Station Flight operates a pair of Chipmunk T10s for communications purposes.

GUTERSLOH, West Germany (RAF)

Gutersloh was taken over by the RAF at the close of WW2 and is today a major base for RAF Harriers. It is currently undergoing transition from the Harrier GR3 to the improved Harrier GR5. No 3 Squadron converted to the new type last year while No 4 Squadron will begin conversion in the near future. Additional aircraft are operated by the Gutersloh Station Flight. The RAF Germany helicopter force (Chinook HC1s of No 18 Squadron and the Puma HC1s of No 230 Squadron) is also stationed at Gutersloh.

HALTON, Buckinghamshire (RAF)

Halton was built on land donated by the Rothschild family in 1917. Throughout the years it has been used for training, and continues in this today through No 1 School of Technical Training. A flying unit is also resident, this being No 613 VGS, equipped with Venture T2s.

HENLOW, Bedfordshire (RAF)

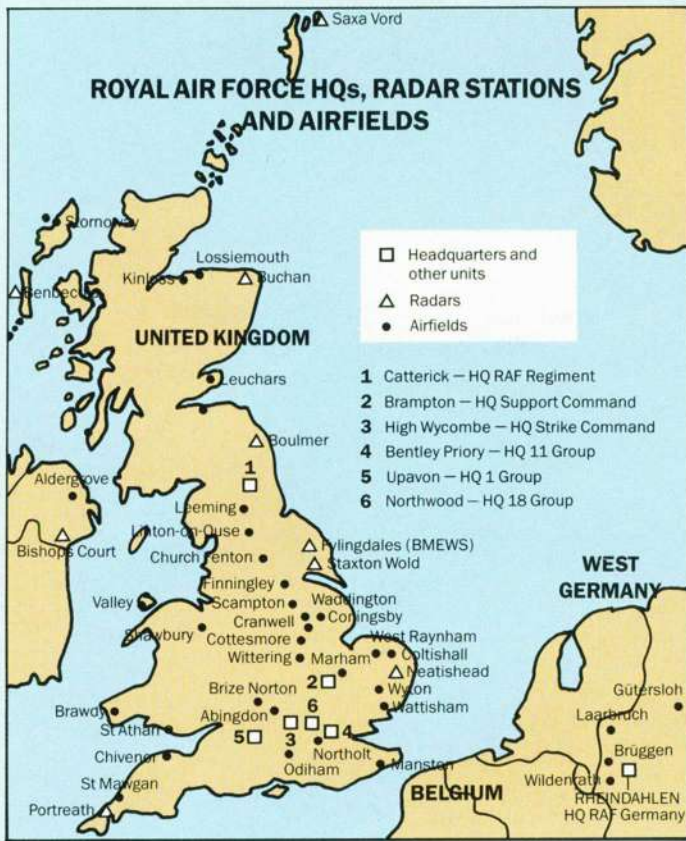
Henlow was opened in 1917 as a repair depot and continued as such until May 1947. Today, there is just one resident flying unit — No 616 VGS, equipped with Venture T2s.

HONINGTON, Suffolk (RAF)

Another product of the RAF pre-war expansion, Honington opened in May 1937 and had a long association with the Buccaneer. The RAF's latest Tornado unit, No 13 Squadron, began to receive GR1As here in October 1989. This is the second Tornado reconnaissance squadron. Also resident at Honington is the Tornado Weapons Conversion Unit, which provides combat training for aircrew.

KINLOSS, Grampian (RAF)

Kinloss celebrated its 50th anniversary in 1989, having had a long association with the maritime reconnaissance role. Today it is home to Nos 120, 201 and 206 Squadrons, all equipped with Nimrod MR2s. A further resident unit is No 663 VGS, which operates Venture T2 powered gliders.



Jetstream T1 used for multi-engine training at Finningley. PRM



A Tornado GR1 of No 27 Squadron which flies from Marham. PRM

LAARBRUCH, West Germany (RAF)

This West German air base was built by the RAF in 1954 and has since been used both as a fighter and bomber station. It currently houses four Tornado units. Three of these — Nos 15, 16 and 20 Squadrons — are dedicated to strike/attack duties while No 2 Squadron has the additional role of tactical reconnaissance.

LECONFIELD, Humberside (Army)

Leconfield was originally opened in December 1936 as a bomber station but was used by several other commands during the ensuing 40 years. Today it is mainly used by the Army, having been handed over in January 1977. It is home to the Sea King HAR3s of 'E' Flight, No 202 Squadron engaged in search and rescue duties.

LEEMING, Yorkshire (RAF)

Opened in 1940 as a bomber station but switching to fighters in 1947, Leeming commenced a refurbishment programme in 1986 which has brought the base into use as a major fighter base. Leeming currently houses three squadrons of Tornado F3s — Nos 11, 23 and 25 Squadrons and also the Bulldog T1s of Northumbrian UAS and the Chipmunk T10s of No 11 AEF.

LEUCHARS, Fife (RAF)

Leuchars is the oldest Scottish military airfield with activity being recorded in 1911 and for the past 40 years has been a fighter base. Today it is undergoing change as the Phantoms of Nos 43 and 111 Squadrons give way to the Tornado F3. One Phantom unit, No 228 OCU, will remain at Leuchars for the foreseeable future. Also resident at Leuchars is 'B' Flight of No 22 Squadron, equipped with Wessex HC2s for search and rescue duties and the Bulldog T1s of Aberdeen, Dundee & St Andrews UAS.

LINTON-ON-OUSE, Yorkshire (RAF)

Linton-on-Ouse was first opened in 1937 as a bomber airfield, but transferred to Fighter Command in July 1946. It remained a fighter base until 1959, when No 1 FTS moved in with the Jet Provost T3A. Today, No 1 FTS remains with Jet

Provosts. Linton-on-Ouse also parents the Bulldogs of the Royal Naval Elementary Flying Training School at Topcliffe. No 642 VGS, equipped with Venture T2 powered gliders, is also resident.

LOSSIEMOUTH, Grampian (RAF)

Although it was built for the RAF in 1939, after WW2 Lossiemouth was turned over to the Fleet Air Arm, remaining as such until 1972. Currently the base is home to the RAF's Buccaneer fleet, which comprises Nos 12 and 208 Squadron plus No 237 OCU. The latter unit also operates a fleet of two-seat Hunters for training duties. The RAF's aged Shackleton AEW2s also reside here with No 8 Squadron. This busy airfield also has a search and rescue element with the Sea Kings of 'D' Flight, No 202 Squadron and provides the training for Jaguar pilots through No 226 OCU.

LYNEHAM, Wiltshire (RAF)

Opened in May 1940, for almost half a century Lyneham has been engaged in the transport role and is today the RAF's major tactical transport base. It is home to the Hercules fleet operated by Nos 24, 30, 47 and 70 Squadrons. Additionally, No 242 OCU conducts Hercules conversion training using based aircraft.

MANSTON, Kent (RAF)

Manston was opened in 1915 as a training base. During WW2 it was used for the Swordfish attack on the German battle cruisers Scharnhorst and Gneisenau in which Eugene Esmonde won the Victoria Cross. Today Manston houses three RAF flying units. Search and rescue duties are carried out by 'C' Flight of No 202 Squadron, using Sea King HAR3s, while No 1 AEF flies Chipmunks and No 617 VGS operates Viking T1 gliders.

MARHAM, Norfolk (RAF)

Since it was reopened in 1937 Marham has seen many different bombers pass through its resident squadrons, including the Mosquito, B-29 Washington, Canberra and Valiant. Today it retains the RAF's last Victors, which serve with No 55 Squadron in the air-to-air refuelling role. The base is also home to two units of Tornado ground/attack aircraft — Nos 27 and 617 Squadrons.

MOUNT PLEASANT, Falkland Islands (RAF)

Mount Pleasant is the RAF's newest base and was purpose built during 1983–85 to enable the Falkland Islands to be defended in case of attack. The airfield supports a variety of aircraft, including Phantom FGR2s of No 1435 Flight, No

A Nimrod MR2P flies over Kinloss, its home airfield.



1312 Flight with Hercules drawn from the Lyneham Transport Wing and No 78 Squadron flying Chinook HC1s for army support and Sea King HAR3s for search and rescue duties.

NEWTON, Nottinghamshire (RAF)

Home of the Air Cadets Headquarters and the RAF Police School, Newton was originally opened in 1940 within Bomber Command. It transferred to training in 1941 and today has two flying units — the East Midlands UAS, equipped with Bulldog T1s, and No 7 AEF, flying the Chipmunk T10s.

NORTH COATES, Humberside (RAF)

North Coates has been an operational RAF base since WW1 and from 1927 has been involved in armament training. It was opened as an airfield in 1935 but its aircraft left in May 1945. A helicopter detachment operated from the airfield from 1956, and in April 1958 the first Bloodhound surface-to-air missiles arrived. North Coates is currently home to 'B' Flight of No 85 Squadron, with these SAMs.

NORTHOLT, Middlesex (RAF)

Opened in 1915, Northolt became synonymous with the Polish volunteer pilots during the Battle of Britain. As the nearest military airfield to Central London, it receives many NATO visitors throughout the year. It is also the base of No 32 Squadron, which provides transport for VIPs throughout the UK and Europe with Andovers, BAe 125s and Gazelles.

ODIHAM, Hampshire (RAF)

Odiham was first opened in 1937 for army co-operation duties but has operated helicopters for the past 30 years. Today two squadrons fly from the base — No 7 Squadron, which is equipped with the Chinook HC1, and No 33 Squadron, which flies the Puma HC1 and conversion training for both squadrons is provided by No 240 OCU.

ST ATHAN, South Glamorgan (RAF)

Opened in 1939, St Athan has been continuously engaged in aircraft maintenance since that time and today is responsible for the Phantom, Harrier and Tornado. It also trains many ground personnel within No 4 School of Technical Training. There are two flying units at St Athan, these being the University of Wales Air Squadron flying Bulldogs, and No 634 VGS with Viking T1 gliders.



ST MAWGAN, Cornwall (RAF)

St Mawgan near Newquay was opened in 1943 and apart from four years spent closed shortly after the war, it has been engaged in maritime work since that time and presently houses the Nimrod MR2s of No 42 Squadron and No 236 OCU. It also acts as Newquay airport, with scheduled services from Brymon Airways.

SCAMPTON, Lincolnshire (RAF)

Another RAF pre-war expansion airfield, Scampton launched the 'Dambusters' raid on the Ruhr Dams in May 1943. A long association with bombers came to an end in 1982 when the Vulcan fleet was withdrawn. The airfield is now home to the Central Flying School with its Jet Provosts, Bulldogs and new Tucanos as well as the RAF Red Arrows Aerobatic Team with Hawk T1As. No 643 VGS is also resident at Scampton, flying Viking T1 gliders.

SEALAND, Cheshire (RAF)

Another airfield with a long history of maintenance work, Sealand housed the RAF's principal aircraft packing depot. Today it has the Viking T1 gliders of No 631 VGS.

Above: The Hawk T1s at Valley have a distinctive red, white and blue colour scheme. PRM

SEK KONG, Hong Kong (RAF/Army)

The RAF's most easterly airfield, Sek Kong is currently home to the Wessex HC2s of No 28 Squadron, which provide support to the military forces within Hong Kong. Also resident at Sek Kong are Scout AH1s of No 660 Squadron Army Air Corps. The airfield is also used by civilian flying clubs and is occasionally visited by the Royal Hong Kong Auxiliary Air Force.

SHAWBURY, Shropshire (RAF)

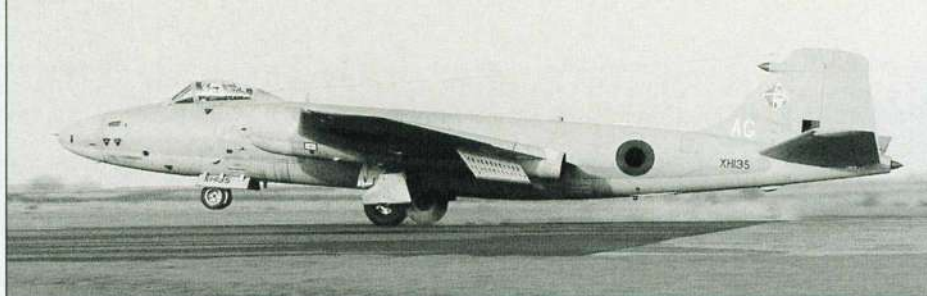
Shawbury opened in 1938 and has been engaged in training duties since that time. Currently it operates the Wessex HC2s and Gazelle HT3s of No 2 Flying Training School, which provides all rotary instruction for the RAF. The Gazelles are also used by the helicopter element of the Central Flying School. No 8 AEF is another resident of Shawbury, flying Chipmunk T10s. The RAF's Central Air Traffic Control School has long been based here. A large number of aircraft are held in store at Shawbury and maintenance of the RAF's lighter aircraft types is carried out.

Celebrating 75 years, No 7 Squadron has Chinook HC1s at Odiham. PRM



Wessex HC2s are operated by No 2 (H)FTS at Shawbury. PRM





A Canberra PR9 of No 1 PRU touching down at Wyton. PRM



Three Nimrod R1Ps are flown by Wyton based No 51 Squadron. Andrew March

SWANTON MORLEY, Norfolk (RAF)

Swanton Morley was opened in September 1940 as a bomber station operating Blenheims, Bostons, Mitchells and Mosquitos. After the war it became the home of No 4 School of Signalling until 1957 and today houses the Viking T1 gliders of No 611 VGS and the Central Servicing Development Establishment.

SWINDERBY, Lincolnshire (RAF)

This former Bomber Command airfield was opened in 1940 and today provides many of the RAF's new aircrew recruits with their first service flying. Potential pilots are assessed using the Chipmunk T10s of the Elementary Flying Training Squadron. It is also home of the RAF School of Recruit Training.

SYERSTON, Nottinghamshire (RAF)

Opened in December 1940 as a bomber station, Syerston was used by Lancasters during WW2 before being passed to Transport Command. No 2 FTS took up residence in November 1957 and eventually Syerston became the first station to train its pilots on jet aircraft with the arrival of the Jet Provost. Today Syerston is the Air Force's main glider base, housing the Air Cadet Central Gliding School with a variety of types including Valiant, Vanguard and Viking gliders and Venture T2 powered gliders.

TERNHILL, Shropshire (RAF)

As well as being a relief landing ground for Shawbury and much used by the Wessex and Gazelle helicopters based there, Ternhill accommodates the Venture T2s of No 632 VGS.

TOPCLIFFE, Yorkshire (Army)

Topcliffe was opened in September 1940 as a bomber station and remained as such throughout WW2. Today it is mainly used by the Army but presently houses the Bulldog T1s of the Royal Navy Elementary Flying Training School, which comes under the aegis of No 1 FTS at Linton-on-Ouse.

UPAVON, Wiltshire (RAF)

Built in 1912, Upavon was the home of the Central Flying School for many years between the wars. As well as being the headquarters of No 1 Group, Strike Command, Upavon houses No 622 VGS with Viking T1 gliders.

Left: Harrier GR5s have replaced the GR3 from 233 OCU and No 1 Squadron at Wittering. PRM

VALLEY, Gwynedd (RAF)

Situated on the Isle of Anglesey, Valley opened as a fighter base in 1941. Presently it is home to No 4 FTS, which shares its Hawk T1 aircraft with the Central Flying School as required. Search and rescue training is done by the SAR Training Unit, while 'C' Flight of No 22 Squadron is also present, both operating Wessex HC2s.

WADDINGTON, Lincolnshire (RAF)

Dating from WW1, Waddington was the first RAF station to receive the Vulcan and is currently home to the last flying Vulcan. Plans to base the RAF's airborne early warning aircraft at this airfield have been protracted with the cancellation of the Nimrod AEW3. The Boeing E-3 Sentry AEW1s for No 8 Squadron are expected here from early in 1991.

WATTISHAM, Suffolk (RAF)

Since it opened in March 1939 Wattisham has been a fighter base and today is responsible for the air defence of southern England. To enable it to fulfil this duty, it has two squadrons of Phantoms. No 56 Squadron is equipped with the FGR2 version, while No 74 Squadron flies the F-4J(UK) variant purchased second-hand from the US Navy in 1984. The airfield is also home to the Bloodhound SAMs of 'E' Flight, No 85 Squadron.

WEST FREUGH, Dumfries & Galloway (MoD PE)

West Freugh was opened in August 1936 as a training base. It began experimental work in 1942 with the arrival of the Bomber Command Experimental Unit, which later became the Bombing Trials Unit and eventually was absorbed into the unit that remains at West Freugh today — the Royal Aerospace Establishment. Aircraft flown include the Buccaneer S2B.

WEST RAYNHAM, Norfolk (RAF)

West Raynham opened in 1939 as part of No 2 Group and continued to operate fixed-wing aircraft until 1975, when its last Canberras left. It is presently the home of the RAF's Bloodhound SAM force and houses both the Headquarters and 'A' Flight of No 85 Squadron.

WILDENRATH, West Germany (RAF)

Opened in 1952, Wildenrath is presently home to three RAF squadrons — Nos 19 and 92 Squadrons, which both fly Phantom FGR2s for air defence duties and No 60 Squadron, which provides transport and communications for RAF Germany. It operates Andovers, which have largely replaced the ageing Pembroke.

WITTERING, Cambridgeshire (RAF)

Another airfield dating from WW1, Wittering has been the UK Harrier base for the past 21 years. It accommodates No 233 OCU for Harrier training alongside front-line No 1 Squadron. The improved Harrier GR5 has entered service with both units and is gradually replacing the older GR3 model, some examples of which are retained by the OCU.

WOODVALE, Merseyside (RAF)

Ever since its opening Woodvale has been engaged in training and after the war was home of the famous THUM Flight. Today it houses both the Liverpool and Manchester UASs, which fly Bulldog T1s, and the Chipmunk T10s of No 10 AEF.

WYTON, Cambridgeshire (RAF)

To Wyton, opened in 1916 and rebuilt in 1935-36, falls the distinction of being the first RAF station to fly a sortie against the Germans in WW2. Today, it houses the RAF's remaining Canberras - No 100 Squadron, which is multi-tasked, No 360 Squadron, which specialises in ECM work, No 1 Photographic Reconnaissance Unit and No 231 OCU, which provides Canberra training. An additional unit is No 51 Squadron, flying Nimrod R1Ps on reconnaissance duties, while the airfield also has the Bloodhound SAMs of 'F' Flight, No 85 Squadron.

OTHER AIRFIELDS WITH RESIDENT RAF FLYING UNITS

Bournemouth-Hurn—No 2 AEF (Chipmunk T10)

Cambridge—No 5 AEF (Chipmunk T10)

—Cambridge UAS (Bulldog T1)

Edinburgh-Turnhouse

—No 12 AEF (Chipmunk T10)

—East Lowlands UAS (Bulldog T1)

Exeter—No 4 AEF (Chipmunk T10)

Filton—No 3 AEF (Chipmunk T10)

—Bristol UAS (Bulldog T1)

Glasgow—Glasgow & Strathclyde UAS
Bulldog T1)

Kenley—No 615 VGS Viking T1)

Kirknewton—No 661 VGS (Viking T1)

Lee-on-Solent—Southampton UAS (Bulldog T1)

Little Rissington—No 637 VGS (Venture T2)

Llanbedr—Royal Aerospace Establishment
(Various)

Predannack—No 626 VGS (Viking T1)

Samlesbury—No 635 VGS (Venture T2)

South Cerney—No 625 VGS (Viking T1)

Swansea—No 636 VGS (Viking T1)

Sydenham—No 13 AEF (Bulldog T1)

—Queens UAS (Bulldog T1)

West Malling—No 618 VGS (Vanguard T1)

Weston-super-Mare—No 621 VGS (Viking T1)

Wethersfield—No 614 VGS (Viking T1)

OPERATIONAL SQUADRONS OF THE ROYAL AIR FORCE 1990

SQN/COMMAND	AIRCRAFT TYPE	OPERATING BASE	SQN/COMMAND	AIRCRAFT TYPE	OPERATING BASE
1 Sqn (Str/1 Grp)	BAe Harrier GR5	Wittering, Cambs	64 Sqn/228 OCU	McD Phantom FGR2	Leuchars, Fife
2 Sqn (RAFG)	Panavia Tornado GR1A	Laarbruch, W Germany	65 Sqn/229 OCU	Panavia Tornado F3	Coningsby, Lincs
3 Sqn (RAFG)	BAe Harrier GR5	Gütersloh, W Germany	70 Sqn (Str/1 Grp)	Lockheed Hercules C1/C3	Lyneham, Wilts
4 Sqn (RAFG)	BAe Harrier GR3/GR5†	Gütersloh, W Germany	72 Sqn (Str/1 Grp)	Westland Wessex HC2	Aldergrove, NI
5 Sqn (Str/11 Grp)	Panavia Tornado F3	Coningsby, Lincs	74 Sqn (Str/11 Grp)	McD Phantom F4J	Wattisham, Suffolk
6 Sqn (Str/1 Grp)	SEPECAT Jaguar GR1A	Coltishall, Norfolk	78 Sqn (Str/FI)	B-V Chinook HC1 and Westland Sea King HAR3	Mount Pleasant, Falklands
7 Sqn (Str/1 Grp)	B-V Chinook HC1	Odiham, Hants			
8 Sqn (Str 11 Grp)	Avro Shackleton AEW2	Lossiemouth, Moray	79 Sqn/1 TWU	BAe Hawk T1A	Brawdy, Dyfed
	Boeing Sentry AEW1*	Waddington, Lincs	84 Sqn (Str/Cyprus)	Westland Wessex HU5C	Akrotiri, Cyprus
9 Sqn (RAFG)	Panavia Tornado GR1	Brüggen, W Germany	85 Sqn (Str/11 Grp)	BAC Bloodhound II	West Raynham, Norfolk
10 Sqn (Str/1 Grp)	BAC VC10 C1	Brize Norton, Oxon	92 Sqn (RAFG)	McD Phantom FGR2	Wildenrath, W Germany
11 Sqn (Str/11 Grp)	Panavia Tornado F3	Leeming, N Yorks	100 Sqn (Str/18 Grp)	EE Canberra B2/T4/E15/TT18	Wyton, Cambs
12 Sqn (Str/18 Grp)	HS Buccaneer S2B	Lossiemouth, Moray	101 Sqn (Str/1 Grp)	BAC VC10 K2/K3	Brize Norton, Oxon
13 Sqn (Str/1 Grp)	Panavia Tornado GR1A	Honington, Suffolk	111 Sqn (Str/11 Grp)	McD Phantom FG1	Leuchars, Fife
14 Sqn (RAFG)	Panavia Tornado GR1	Brüggen, W Germany			
15 Sqn (RAFG)	Panavia Tornado GR1	Laarbruch, W Germany	115 Sqn (Str/1 Grp)	HS Andover E3/E3A	Benson, Oxon
16 Sqn (RAFG)	Panavia Tornado GR1	Laarbruch, W Germany	120 Sqn (Str/18 Grp)	BAe Nimrod MR2	Kinloss, Moray
17 Sqn (RAFG)	Panavia Tornado GR1	Brüggen, W Germany	151 Sqn/2 TWU	BAe Hawk T1A	Chivenor, N Devon
18 Sqn (RAFG)	B-V Chinook HC1	Gütersloh, W Germany	201 Sqn (Str/18 Grp)	BAe Nimrod MR2	Kinloss, Moray
19 Sqn (RAFG)	McD Phantom FGR2	Wildenrath, W Germany	202 Sqn (Str/18 Grp)	Westland Sea King HAR3	Finningley, S Yorks also Boulmer, Brawdy, Manston, Lossiemouth and Leconfield
20 Sqn (RAFG)	Panavia Tornado GR1	Laarbruch, W Germany			
22 Sqn (Str/18 Grp)	Westland Wessex HC2	Finningley, S Yorks also Chivenor, Devon; Coltishall, Norfolk; Leuchars, Fife			
			206 Sqn (Str/18 Grp)	BAe Nimrod MR2	Kinloss, Moray
23 Sqn (Str/11 Grp)	Panavia Tornado F3	Norfolk; Leuchars, Fife	208 Sqn (Str/18 Grp)	HS Buccaneer S2B	Lossiemouth, Moray
24 Sqn (Str/1 Grp)	Lockheed Hercules C1/C3	Leeming, N Yorks	216 Sqn (Str/1 Grp)	Lockheed TriStar K1/KC1	Brize Norton, Oxon
25 Sqn (Str/11 Grp)	Panavia Tornado F3	Lyneham, Wilts	230 Sqn (RAFG)	Westland Puma HC1	Gütersloh, W Germany
27 Sqn (Str/1 Grp)	Panavia Tornado GR1	Leeming, N Yorks	234 Sqn/1 TWU	BAe Hawk T1A	Brawdy, Dyfed
28 Sqn (Str/Direct)	Westland Wessex HC2	Marham, Norfolk	360 Sqn (Str/18 Grp)	EE Canberra T17/T17A	Wyton, Cambs
29 Sqn (Str/11 Grp)	Panavia Tornado F3	Sek Kong, Hong Kong	617 Sqn (Str/1 Grp)	Panavia Tornado GR1	Marham, Norfolk
30 Sqn (Str/1 Grp)	Lockheed Hercules C1/C3	Coningsby, Lincs			
31 Sqn (RAFG)	Lockheed Hercules C1/C3	Lyneham, Wilts			
32 Sqn (Str/1 Grp)	Panavia Tornado GR1	Brüggen, W Germany			
	HS Andover CC2, BAe 125, and Westland Gazelle HT3/HC4	Northolt, Middx			
33 Sqn (Str/1 Grp)	Westland Puma HC1	Odiham, Hants			
38 Sqn/236 OCU	BAe Nimrod MR2	St Mawgan, Cornwall			
41 Sqn (Str/1 Grp)	SEPECAT Jaguar GR1A	Coltishall, Norfolk			
42 Sqn (Str/18 Grp)	BAe Nimrod MR2	St Mawgan, Cornwall			
43 Sqn (Str/11 Grp)	Panavia Tornado F3	Leuchars, Fife			
45 Sqn/TWCU	Panavia Tornado GR1	Honington, Suffolk			
47 Sqn (Str/1 Grp)	Lockheed Hercules C1/C3	Lyneham, Wilts			
51 Sqn (Str/18 Grp)	BAe Nimrod R1	Wyton, Cambs			
54 Sqn (Str/1 Grp)	SEPECAT Jaguar GR1A	Coltishall, Norfolk			
55 Sqn (Str/1 Grp)	Handley Page Victor K2	Marham, Norfolk			
56 Sqn (Str/11 Grp)	McD Phantom FGR2	Wattisham, Suffolk			
60 Sqn (RAFG)	HS Andover C1/CC2	Wildenrath, W Germany			
63 Sqn/2 TWU	BAe Hawk T1A	Chivenor, N Devon			

OPERATIONAL FLIGHTS

FLT/COMMAND	AIRCRAFT TYPE	OPERATING BASE
1312 Flt (Str/FI)	Lockheed Hercules C1K	Mount Pleasant, Falklands
1417 Flt (Str/Dir)	BAe Harrier GR3	Belize City Airport
1435 Flt (Str/FI)	McD Phantom FGR2	Mount Pleasant, Falklands
1563 Flt (Str/Dir)	Westland Puma HC1	Belize City Airport
1 PRU (Str/18 Grp)	EE Canberra PR9	Wyton, Cambs
The Queen's Flight (Str/1 Grp)	BAe 146 CC2, HS Andover CC2, Westland Wessex HCC4	Benson, Oxon

Notes:

* Squadron not yet formed with this type/at this base.

† Squadron not yet equipped with this type.

Squadron numbers in *italics* denote a 'shadow' squadron for the unit that follows.

HQ STRIKE COMMAND (HIGH WYCOMBE)	
No 1 GROUP (UPAVON)	No 11 GROUP (BENTLEY PRIORITY)
STRIKE/ATTACK: TORNADO GR1 2	AIR DEFENCE: TORNADO F3 7
OFFENSIVE SUPPORT: JAGUAR 2	PHANTOM 2
HARRIER 1	BLOODHOUND 1
RECONNAISSANCE: JAGUAR 1	RAPIER 1
TORNADO GR1A 1	MISSILES 2
TANKER & TRANSPORT: TRISTAR 1	SKYGUARD 1*
VC10 1	GROUND DEFENCE: FIELD SQN 1*
VC10 K2/K3 1	AIRBORNE EARLY WARNING: SHACKLETON 1
VICTOR K2 1	
HERCULES 4	
HS 125/ANDOVER 1	
CHINOOK 1	
PUMA 1	
WESSEX 1	
GROUND DEFENCE: LIGHT ARMOUR 4	
FIELD SQN 4*	
RAF REGT 1	
The Queen's Flight BAe 146/Andover/Wessex	

*Manned by R Aux AF

HONG KONG	CYPRUS	BELIZE
WESSEX 1 SQN	WESSEX 1 SQN RAF REGT 1 SQN	HARRIER 1 FLT PUMA 1 FLT RAF REGT 1/2 SQN
RAF GERMANY (RHEINDAHLN)	FALKLAND ISLANDS	
STRIKE/ATTACK: TORNADO GR1 7	AIR DEFENCE: PHANTOM 1 FLT RAPIER MISSILES 1 SQN	
OFFENSIVE SUPPORT: HARRIER 2	TANKER/RECONNAISSANCE: HERCULES 1 FLT	
AIR DEFENCE: PHANTOM 2	AIR TRANSPORT/SEARCH AND RESCUE: CHINOOK 1 SQN SEA KING 1 SQN	
RAPIER 4		
RECONNAISSANCE: TORNADO GR1A 1		
AIR TRANSPORT: CHINOOK 1		
PUMA 1		
PEMBROKE 1		
GROUND DEFENCE: LIGHT ARMOUR 1		



A line up of Tornado GR1s of Honington's Tornado Weapons Conversion Unit. PRM

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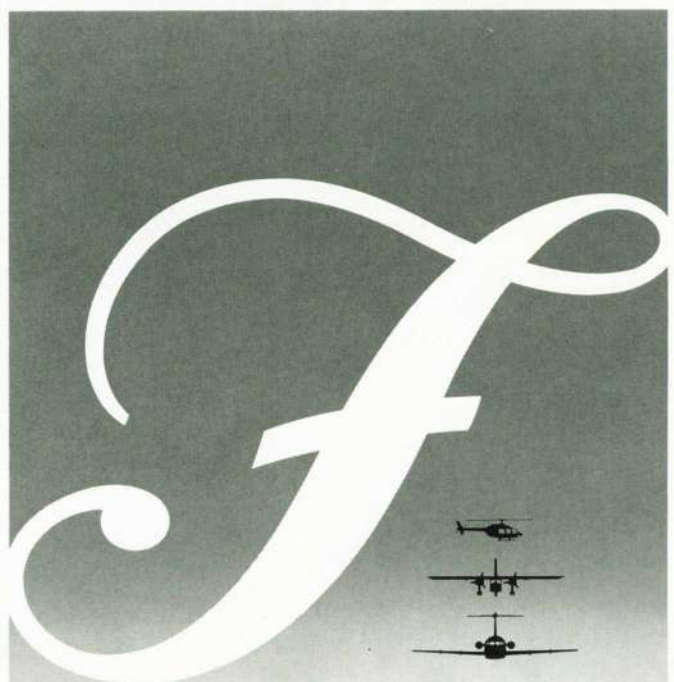
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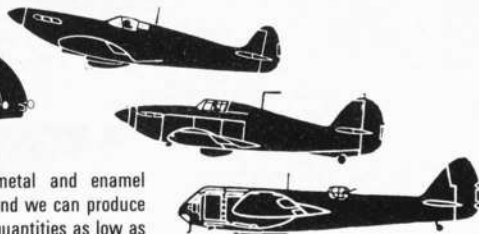
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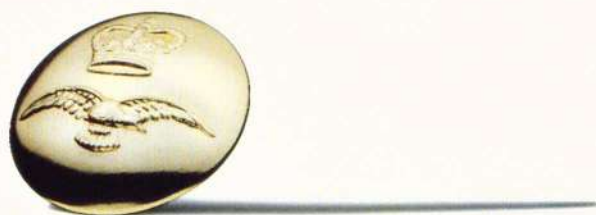
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