

Royal Air Force



YEARBOOK 1989

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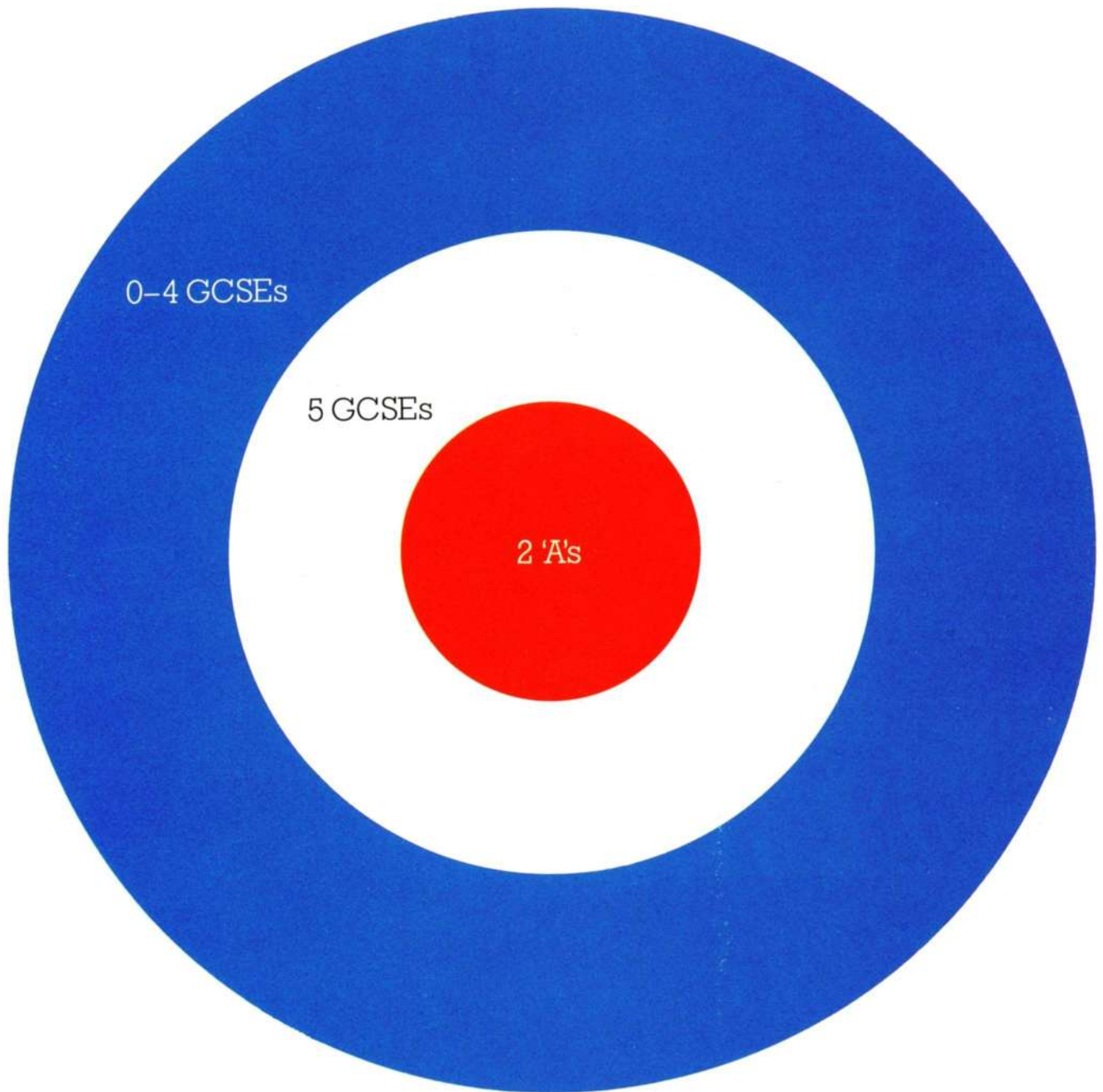
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ROYAL AIR FORCE

Royal Air Force

YEARBOOK 1989



INTRODUCTION Air Chief Marshal Sir Peter Harding GCB, ADC, FRAes, CBIM, RAF	5	RAF LEEMING — T. Malcolm English	55
EXERCISE GOLDEN EAGLE Squadron Leader Martin Halsall	7	GOODBYE JP Peter R. March	59
CANBERRA — 40 YEARS ON Edwin A. Shackleton	12	A HELPING HAND IN HONG KONG Sue J. Bushell	65
1939 — THE RAF GOES TO WAR John D. R. Rawlings	21	SAFETY FROM THE FLAMES Paul Jackson	68
KEEPING THE TORNADO FLYING Peter R. March	28	MULTI ROLE HAWK Peter R. Foster	70
THE BATTLE OF BRITAIN HALL R. Simpson	35	CASTLES OF THE AIR Michael J. F. Bowyer	75
41(F) SQUADRON Lindsay Peacock	40	STUDENT FLIERS T. Malcolm English	79
THE SAME BUT DIFFERENT Paul Jackson	45	RSS — REPAIRERS TO THE ROYAL AIR FORCE	84
SILVER JUBILEE OF THE RED ARROWS Andrew March	51	BDR — BATTLE DAMAGE REPAIR Sue J. Bushell	87
		THE RAF'S YEAR 1988 Brian Strickland	87
		OPERATIONAL SQUADRONS OF THE RAF	90



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ROYAL AIR FORCE CHARITIES



The Royal Air Forces Association and the Royal Air Force Benevolent Fund work closely together in the interests of the Royal Air Force 'family' and specifically in the relief of distress. They are entirely complementary, with the Association providing the vital and friendly contact with individual members of the 'family' who are in need or distress and the Fund providing the financial support to meet those needs.

Both organisations are Registered Charities. **The Fund** was founded in 1919 to relieve need or distress amongst Royal Air Force serving or ex-service men or women and their dependants regardless of rank, race, colour or creed. Eligibility lasts for life and the response of the Fund to requests for help is decided by a completely independent and voluntary group of people.

The Association has a membership of over 110,000 and over 600 branches worldwide. Membership is open to serving and ex-service men and women of all ranks and can include Royal Flying Corps and Air Forces of the Commonwealth. The Association's welfare work is not, however, confined to its membership but is extended to serving and ex-Air Forces non-members and their dependants. The level of distress in the RAF 'family' is high and this is reflected in the number of

awards made by the RAF Benevolent Fund; in 1988, 15,000 beneficiaries shared £8½ million.

Both the Fund and the Association maintain homes for the elderly. The Association has **Sussexdown** to house up to 60 chronically sick or severely disabled residents and a small number of convalescent cases. It also maintains **Richard Peck House** for 22 convalescents. The Fund owns **Princess Marina House** on the Sussex coast, with a total of 111 residents and convalescents and, in Aberdeenshire, it maintains **Alsastrean House** for 40 residents. The Association operates sheltered Housing schemes at **Storrington** and **Bolton** and both Fund and Association have joined together to set up sheltered housing at **Moffat** in memory of Lord Dowding.

The complementary nature of the way both Organisations function is fundamental to the success of their welfare work. This welfare workload is increasing and looks set to go on doing so over the next decade, at least. Both Organisations will benefit from the sale of this Yearbook and are grateful for your support in this, but if the increased demands on their resources are to be properly met, they will need your continuing support. Please give it, for we cannot function adequately without it.



**"TWO YEARS AGO, I LOST MY HUSBAND.
THANKS TO YOU, WE WON'T LOSE OUR HOME!"**



**THE
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**Air Chief Marshal
Sir Peter Harding,**
GCB, ADC, FRAeS, CBIM, RAF
Chief of the Air Staff

INTRODUCTION

Fifty years ago the United Kingdom became involved in what eventually turned out to be the second great World War fought this century. Throughout 1989 and in the following years, as 50th anniversaries occur, we shall be remembering the great events and battles of that war. We shall recall with sadness the losses and sacrifices, and with pride the victories and achievements.

There were many lessons which were learnt from that conflict but, above all, two have proved enduring. The first is that peace is not secured by good intentions or wishful thinking, but by peaceful policies backed by an effective military capability. So long as a potential aggressor maintains significant military forces, they must be matched on our part by effective defences, even when there is apparently no immediate likelihood of conflict, for intentions can change overnight but capabilities, once surrendered, take a very long time to regain. We saw this all too clearly in the 1930s.

Moreover, as World War II progressed, it rapidly became apparent that the military capability necessary for victory could only be achieved through an alliance of free peoples. In most of the years since then, this requirement to act in concert with our friends has proved as essential to maintaining peace with freedom as it was to winning it in the first place. It is entirely appropriate, therefore, that 1989 marks another important anniversary: the 40th anniversary of the founding of the North Atlantic Treaty Organisation. NATO has successfully deterred war in Europe for longer than many reading this Yearbook have been alive. Given the turbulent history of our continent, that is a remarkable achievement.

The second enduring lesson to emerge from World War II was the importance of air power. Without mastery of the air our forces almost invariably went into retreat; with air superiority or better still supremacy, they advanced to victory, and this was true just as much at sea as it was on land. As General — later Field Marshal Lord — Montgomery recognised at the time, control of the air was “a factor of battle-winning importance”. The many conflicts that have flared up in various parts of the world since 1945 have only served to underline the crucial role of air power in modern military operations.

Drawing together these two lessons, it is clear that one of the key ingredients for security in Western Europe is a strong air force operating within the framework of a cohesive alliance — and that is exactly what the United Kingdom has today. The Royal Air Force continues to provide well-equipped, highly professional forces for a wide variety of roles. And these forces continue to be updated with modern aircraft and equipment such as the Tornado GR1 and F3 and of course the Harrier GR5, described in this Yearbook.

Peter Harding



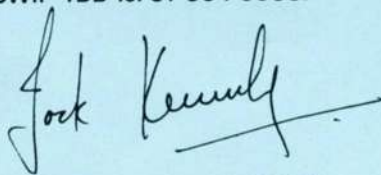


50 **BATTLE OF BRITAIN** **SALUTE**

Please take a good look at the 'logo' above. It is one which I hope you will be noticing a great deal during 1990 because next year, the 50th anniversary of the Battle of Britain, the **Royal Air Force Benevolent Fund**, with the wholehearted support and active involvement of the **Royal Air Force** and **The Royal Air Forces Association**, will be marking the anniversary with a series of major events around the country.

The purpose will be three-fold. First, to celebrate one of the most crucial defensive battles in our history. Second, to use the opportunity to remember all those who fought in the Royal Air Force before the Battle and in the subsequent campaigns which brought us eventual victory — campaigns which would not have taken place, however, without the successful outcome of the Battle of Britain. We want to salute and remember the very many thousands from Bomber and the other Commands who died, were wounded or taken prisoner, because our third objective is to raise much-needed money so that we can continue to look after the growing number of veterans who will be turning to us in their vulnerable years. Last year nearly 70% of our 15,000 beneficiaries were World War II survivors and this proportion is set to increase dramatically.

The Fund will be organising the celebrations through its own Company, the Royal Air Force Benevolent Fund's Battle of Britain Appeal Ltd, and aims to raise £20 million over and above its normal annual requirement as a result of them. To reach this ambitious but necessary target, we shall need the help of individuals and organisations everywhere. If you would like to be involved, or simple like to know more, please contact the Appeal Unit at 16 Regency Street, London SW1P 4DB Tel 01 834 6680.




Air Chief Marshal Sir Thomas Kennedy GCB AFC
Controller, Royal Air Force Benevolent Fund





Squadron Leader Martin Halsall takes us around the world by Tornado F3, giving his impressions of Exercise

Peter Scott, Rolls-Royce



GOLDEN EAGLE

From the sun-drenched beaches of Penang Island, Malaysia to the cultural attractions of Bangkok, Thailand; from the endless shopping in Singapore to Australia, Hawaii, California and Pennsylvania, this was Exercise *Golden Eagle* — the first circumnavigation of the globe by Royal Air Force fighters: Tornado F3s of No 29 (Fighter) Squadron based at Royal Air Force Coningsby.

Now, to those of you familiar with RAF aircrew, and especially fighter crews, you will understand what shudders of alarm the prospect of ten weeks around the world would send down the spine of even the most steely-eyed fighter-types! The Squadron was alive with rumour and counter-rumour. Gradually the plot unfolded: the prime reason for the detachment was to deploy fighter aircraft to Malaysia in support of the Malaysian Peninsular five nation defence arrangement. Britain has been a signatory since 1971, but this was to be the first time that this country had deployed fighter assets. The culmination of the three week detachment to Malaysia would be Exercise *Lima Besatu 88*; a four day exercise involving Malaysian, Singaporean, Australian and British Forces.

The four Tornado F3s from No 29 (Fighter) Squadron left Coningsby on 21 August 1988. We were sad to leave behind the last vestiges of the 'scorching summer' which had bathed the UK in temperatures of 15°C for weeks on end! As we landed 9½ hours later in Oman all our sadness disappeared. It was 7pm and dusk — but the temperature was 32°C and the humidity very high. We were met at the entrance of our excellent hotel by the management and waiters with trays of complimentary drinks. One felt that *Golden Eagle* was going to be an outstanding detachment!

On to Malaysia and three super weeks on Penang Island, an exotic paradise lying three miles off the mainland. Butterworth Air Base was an hour's drive from the hotel, but the journey was worth it as our accommodation was excellent.

The flying in Butterworth was mixed and most enjoyable: from low flying over Malaysia and mixed fighter force tactics with Malaysian and Singaporean Northrop F5s, to dissimilar air combat with Australian F-18 Hornets. We received an excellent welcome and there was intense interest in ourselves and the Tornado. Little did we realise however, what was happening behind closed doors. Before the detachment had left South East Asia, the Malaysian Government had signed a memorandum of understanding with Britain for a multi-billion pound defence contract, to include Tornado aircraft!

We left Malaysia on 26 September to fly to Korat in Thailand. The Royal Thai Air Force had invited us to use its Air Combat Manoeuvring Range. An intense air combat programme had been devised, leading on from initial one versus one basic combat manoeuvres to a complex four v four v four scenario. The Thais were a delightful people. They made us extremely welcome and the country was all the more interesting because we were in a non-tourist area and were something

of a novelty for the local townspeople.

It was with much regret and not a little sorrow that we interrupted our time in Korat for a weekend in Bangkok. What a city! Many of the squadron adopted tourist mode and visited the Bridge on the River Kwai, the Grand Palace, the Rose Garden Cultural Centre and the floating market. I went to bed with a good book each night, but I did hear from a friend that the night life in Bangkok was extraordinary! All too soon our time in Thailand was past. We had been well looked after by our hosts; the country certainly deserved its title as the Land of Smiles and it has, without doubt, the most beautiful girls in the world!!

We landed in Singapore on 24 September. Our time on the island was to be spent giving presentations, not only to the Singaporeans, but also to the Malaysians (in Kuala Lumpur) and the Indonesians (in Jakarta). A hand-picked set of smart, good looking, fit air and groundcrew who were the cream of the Royal Air Force were not available and so we went! The aircrew wore tailored grey flying suits for all the presentations and very smart we looked too! Various official receptions were held in embassies and high commissions to host local military and political dignitaries and to give them a chance to talk to the operators. There was intense interest wherever we went. The RAF had not had such a presence in this part of the world for nearly 15 years and many people did seem pleased to see us again.

On 5 October the replacement personnel arrived on a Tristar from Coningsby. There was the chance on the one remaining night in Singapore for the Officers to have a dining-in night in the Raffles Hotel, Singapore; it had to be done! All too soon most of those who had set out from England some seven weeks before were heading homewards whilst the Golden Eagle circumnavigation continued — the next step was



Singapore to Darwin.

There had already been contact between the RAF and the RAAF in Malaysia (both professional and social) but nevertheless we received a super welcome down-under. Unfortunately it was only an overnight stop in Darwin and then we flew almost the length of Australia to Williamstown on the east coast. This was to be the F3 base during the huge Bi-centennial Air Show at RAAF Richmond. There was some historic flying while we were there — F3 over Sydney Harbour bridge, F3 over the Brisbane Expo 88 site and so on; but this was mainly a social event — we were flying the flag and thoroughly enjoying contributing in our little way to the celebrations. The air show was enormous and they entertained royally with Australian/British relations reaching a new high.

We attended the Australian's Oktoberfest and took our own Batemans Real Ale. But again all too soon our time was up and we began the long trek across the Pacific en route back home. First stop was Pago Pago on Western Samoa. All

went well until contact was made with air traffic control at the air base at a range of 200 miles. The air traffic controller promptly announced that he was shutting up shop in five minutes and we were on our own. The number of diversion options in this area is severely limited! However we all landed safely and breathed a huge sigh of relief. Next day we were off to Hawaii. Sadly, it only meant an overnight stop of about 14 hours — hardly long enough to even begin to look for Magnum.

Another long-haul brought us to California and Travis Air Base; the overflight of San Francisco at 5000 ft including Alcatraz was memorable. We crossed five states to Harrisburg on the east coast. Here too they were having an air show and the F3 was again displayed. Indeed they were so impressed that we had come all that way and were able to take part in the air show that they named Sunday 'RAF day'! Once the air show was over we set out on our penultimate leg: Harrisburg to Goose Bay in Canada. After another overnight stop we were off on the final leg back across the Atlantic.

Our arrival back at RAF Coningsby, the home of No 29 (F) Sqn, was seven minutes late — which considering we had been 26,000 miles was not too bad. There was considerable media interest from TV, Radio and the press amid joyful scenes of family reunions, as some of the team had been away 11 weeks, including the first RAF fighter crew to circumnavigate the world: Wing Commander Lloyd Doble (Officer Commanding 29 Squadron) and Squadron Leader Phil Goodman.

It had been months in the planning. It had been the very devil to plan. It had involved the RAF's newest fighter operating in temperatures of up to 100°F, 12,000 miles from home. But it had all worked marvellously and the tired but proud crews of No 29 Squadron would have loved (after a short rest!) to do it all over again.

A pair of No 29 Squadron Tornado F3s await take-off at RMAF Butterworth, Malaysia, during the five nation Lima Bersatu 88 exercise.





Two RAAF F/A-18 Hornets formate on a Tornado F3 over Penang Island, Malaysia. Peter Scott, Rolls-Royce



Tornado F3 ZE759 above the infamous 'Bridge over the River Kwai' in Thailand. Geoff Lee, BAe



Aircrew from No 29 Squadron, RAF and No 144 Squadron, Royal Singapore Air Force, planning a sortie.



Bedecked with garlands, No 29 Squadron aircrew line-up with their Thai counterparts at Korat. Sqn Ldr Martin Halsall



Homeward bound Tornado F3s over Greenland. Allan Burney





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Tornado Air Defence Variant in service with the RAF and chosen for The Royal Saudi Air Force and the Sultan of Oman's Air Force

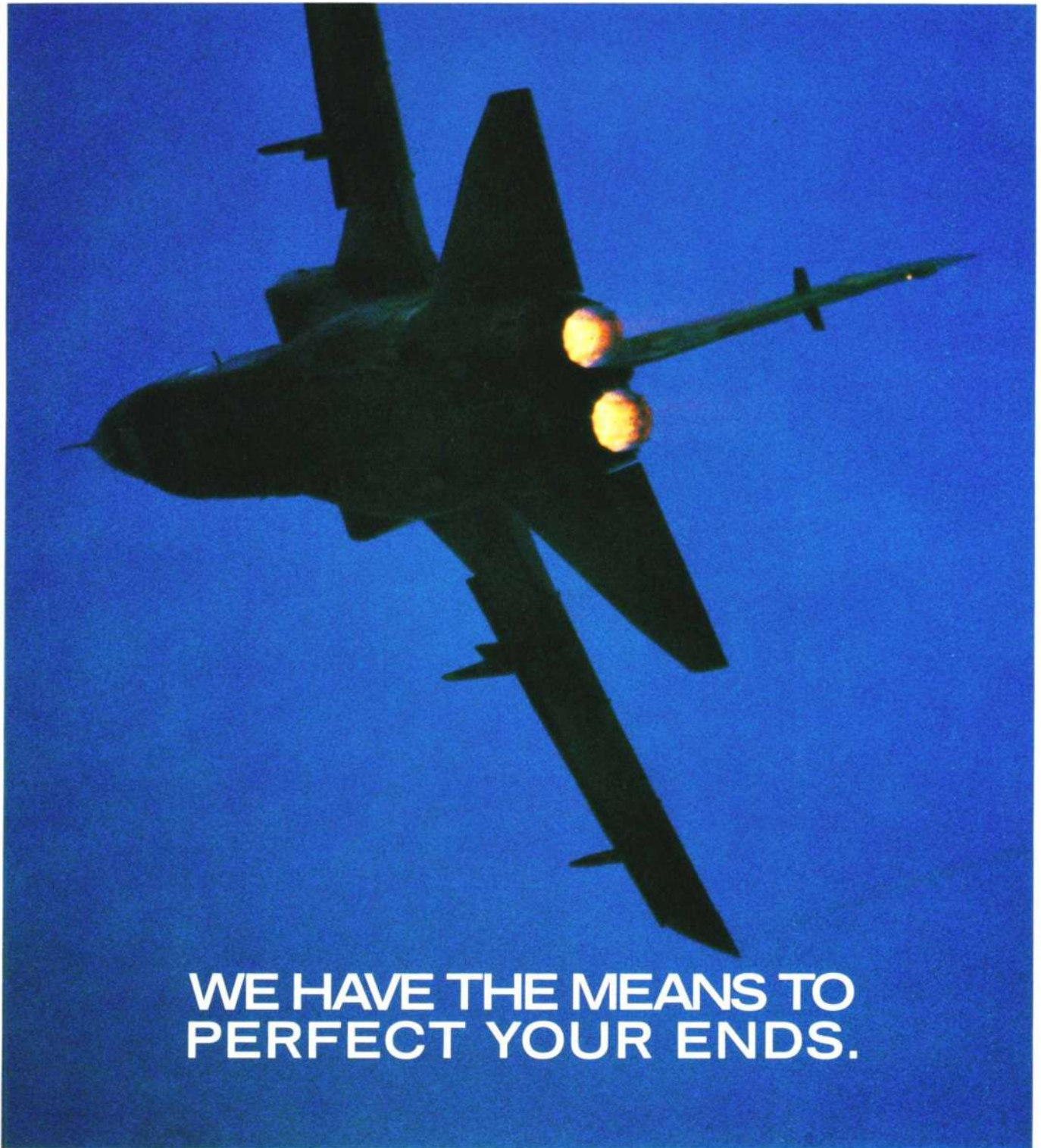


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T E C H N O L O G Y Y O U C A N T R U S T

CANB

40 YEARS ON



The beginning of an era — prototype Canberra VN799. British Aerospace



Edwin A Shackleton outlines the veteran bomber's RAF service and visits Wyton — the home of today's Canberra fleet.

Britain's first jet bomber, the English Electric Canberra, took to the air just 40 years ago. The Canberra was designed to Air Ministry specification B3/45 by W.E.W. (Teddy) Petter, Chief Engineer of English

ERRA



Above: Canberra T17A WD955 No 360 Squadron – the RAF's longest serving Canberra. Peter R. March

Electric, to carry a bomb load of 6000lb over a radius of 750 miles and, like the Mosquito, to be sufficiently agile to outfly attacking fighter aircraft.

The prototype Canberra B1, VN799, made its maiden flight in the hands of Roland Beamont from Warton on Friday 13 May 1949 and was displayed four months later at the SBAC Show at Farnborough, where its manoeuvrability and performance was impressive. In the development stage the design requirement was changed from that of a 'radar sighting' bomber to a visual bomber with accommodation for a bomb aimer in the transparent nose. This materialised in the

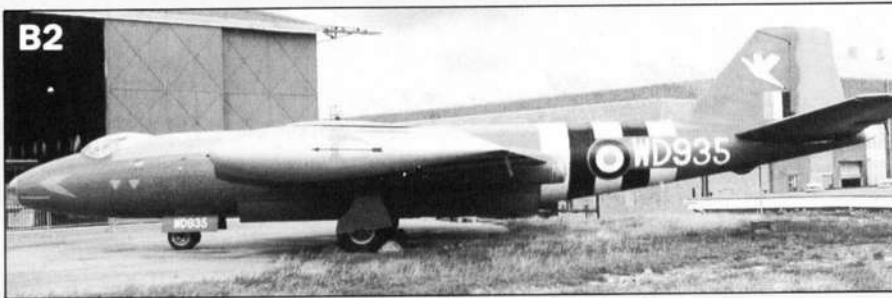
first production version, the Canberra B2.

The first Canberra delivery to a Royal Air Force squadron was in May 1951, to No 101 Squadron based at Binbrook, which became operational in January 1952. The second unit was the *Dam Busters* squadron, No 617, also at Binbrook. This was followed by 25 more squadrons over the next four years, both in the UK and abroad. Detachments saw service in Malta and Cyprus in the Suez campaign, in Malaya against the communist guerillas and in Australia in support of nuclear tests.

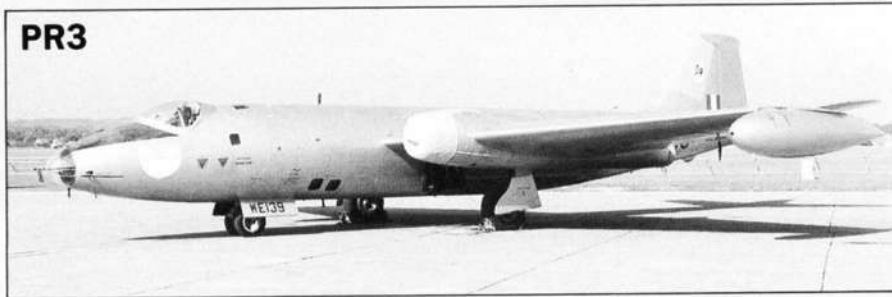
Meanwhile, numerous versions of the Canberra were being developed,

establishing the design's versatility. First was the PR3 for photo-reconnaissance which served with five squadrons. Canberra PR3 WE139 won the England to New Zealand Air Race in 1953. This aircraft is now preserved in the RAF Museum. Then came the T4 dual control trainer, recognisable by its solid nose, which first flew on 12 June 1952.

The B5, flown only as a prototype from July 1951, was a visual target marker version with integral wing fuel tanks. It was subsequently used for development and record breaking purposes, making the first out and back crossing of the North Atlantic in one day from Aldergrove to



B2



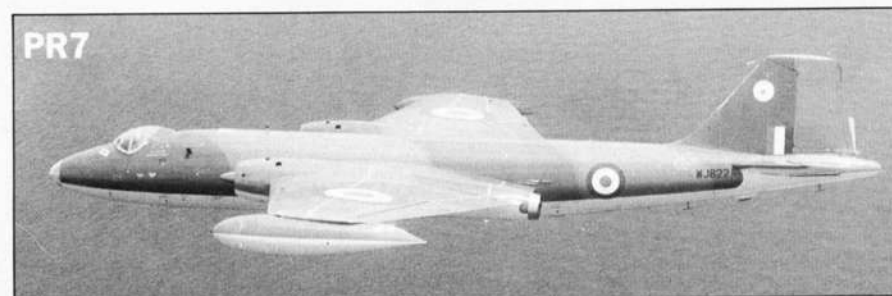
PR3



T4



B6



PR7



B(1)8

Gander, on 26 August 1952.

The Canberra B6 was an updated version of the original B2 light bomber with 7500lb thrust R-R Avon 109 turbojets replacing the B2's 6500lb Avon 101s and was distinguished by its longer engine intake centre bullets. First squadron deliveries were made in June 1954 and total production was 113 aircraft. The B(1)6 was a multi-role strike bomber fitted with four 20mm cannon in an under-fuselage pod, but retaining the bomber capability. It was an interim version pending development and delivery of the interdictor B(1)8. The PR7 was the photo-reconnaissance version of the B6 and served with ten RAF squadrons, of which No 542 Squadron was the first to equip on 17 May 1954.

Converted from the B5 prototype, the B(1)8 was the first major redesign of the Canberra. It had a single, fighter type canopy offset to port, which gave a greatly improved view for the pilot, while the navigator/bomb aimer was moved to a lower nose position. The cannon pod, as on the B(1)6, was fitted to this version, which first flew on 23 July 1954. Initial delivery was to No 88 Squadron at Wildenrath in January 1956. This versatile type served with five squadrons in RAF Germany as an interdictor/bomber, until replaced by Buccaneers, Phantoms and Harriers by mid-1972.

The PR9 was the ultimate photo-reconnaissance version, featuring a new wing of nearly 4ft greater span and increased chord at the centre section. It was powered by two 11,250lb st Avon 206 turbojets, 50% more powerful than the Avon 109s of the PR7. The prototype was converted by Napier, with the production of 22 aircraft by Shorts at Belfast.

Differing from the B(1)8, the single pilot canopy on the Canberra PR9 was hinged rearwards for external ladder entry while the navigator entered via a sideways-hinged nose. Three squadrons were equipped with this variant.

All of the subsequent marks of Canberra were conversions for specific duties. The T11, which was first flown on 29 March 1958, was modified from the B2 by Boulton Paul for the training of AI radar operators. It had an extended nose radome, as did the T19, which was converted from the T11, with its radar removed.

B15s and B16s were multi-role versions of the B6 for operations with the Far East and Near East Air Forces. A total of 60 were modified by Bristol Aircraft and Marshall of Cambridge, with underwing pylons for two 1000lb bombs or Microcell packs for 37 two-inch rockets. They also had additional camera capacity. This version served for a decade with the Akrotiri Wing in Cyprus and with No 45 squadron in Singapore. The last aircraft was retired at Tengah in January 1970.

Some of the B15s were subsequently modified to E15 standard by the removal of the weapons system and the addition of Decca navigation and other equipment for use by No 98 Squadron (later No 100 Squadron), for radar and radio calibration duties.

The Canberra T17 electronic coun-

termeasures (ECM) trainer version, with its rounded radar nose and four mini bulges, was modified from retired B2s. The first of 18 conversions was delivered to No 360 Squadron at RAF Watton in December 1966. Two-thirds of these remain in service today with this squadron at Wyton, its base since moving from Cottesmore in July 1975.

The most colourful Canberra mark is the TT18 target tug, having black and yellow striped undersurfaces. The TT18 entered service in May 1970 with No 7 Squadron at St Mawgan and is now operated by No 100 Squadron at Wyton.

Total production of the Canberra in the UK was 925, with a further 48 being produced in Australia and 403 in the USA – the latter designated B-57. Although the Canberra was designed and produced by English Electric, the early demand was met with additional production by Avro, Handley Page and Shorts who built 75, 75 and 60 B2's respectively. The latter manufacturer also produced 49 B6s, 12 B(1)8s and was also responsible for the complete production batch of 23 PR9s for the RAF.

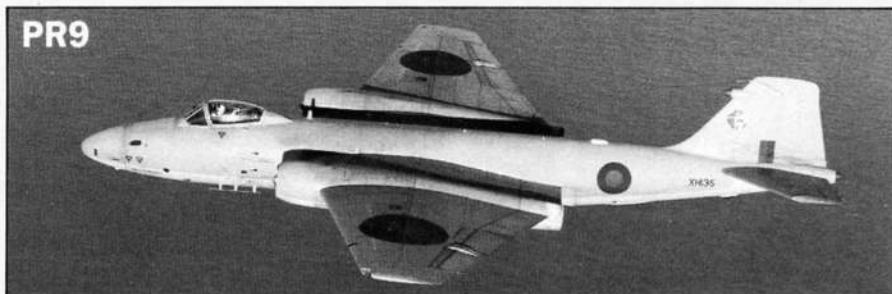
The most numerous of the Canberra marks was the B2 (with 418 produced), equipping 44 RAF squadrons at different periods. The Canberra B2, which replaced the ageing Lincoln and the interim B-29 Washington, took the RAF into the jet bomber era and doubled the bombing and height capability in one step. Eventually the Canberra's major rôle was partly taken over by the Valiant, Victor and Vulcan, whilst other squadrons were disbanded as a result of major Government defence cuts in 1967.

The Canberra continued in RAF service through the 1970s and into the 1980s for photo-reconnaissance, training and other specialist roles, due to its sound design, reliability and comparative economy. As the number of Canberra units decreased it was decided in 1982 that the remaining four would be co-located at RAF Wyton, just east of Huntingdon. Currently based there are Nos 100 and 360 Squadrons, No 1 PRU and No 231 OCU, which together operate over 40 Canberras of seven different marks.

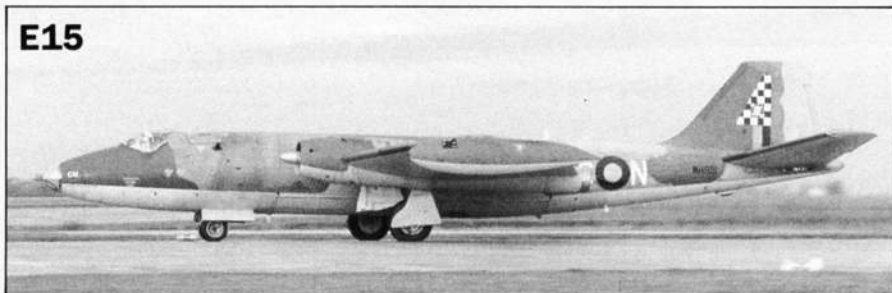
No 100 Squadron was re-formed at West Raynham with Canberras for target facilities duties on 1 February 1972, moved to Marham in January 1976 and then to Wyton with its B2s and E15s on 5 January 1982. The duties are today carried out by Canberra B2, PR7, E15 and TT18 variants, totalling almost half of the resident Canberra force. The PR7s were obtained on the disbandment of No 13 Squadron and the TT18s came from No 7 Squadron at St Mawgan. The squadron works in conjunction with all three armed forces and NATO to provide aerial targets in various forms.

Rushton high-speed targets for live firing, by either ground-based or air launched guns and missiles are towed from underwing pods on the TT18s, which unreel to a cable length up to 22,000 ft. Air-to-air targets or 'banners' are towed on 900 ft of composite cable which is taken off with the Canberra and released back at the home base before landing.

PR9



E15



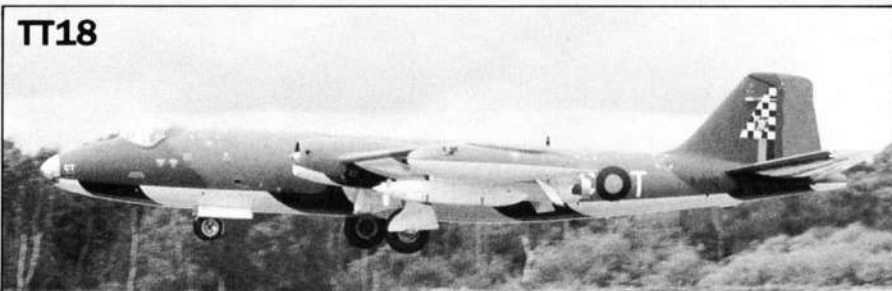
B16



T17



TT18



T19





Top: Canberra T4 WT478 No 231 OCU. Above left: Canberra TT18 WJ715 No 100 Squadron. Above right: Canberra PR7 WT519 No 100 Squadron. Photographs Peter R. March

Squadron aircraft fly as the 'enemy' for fighter aircraft, ground-to-air missile units, and RAF and Naval air defence training. E15s are used primarily for radar calibration and the flight checking of new radar installations. PR7s have a chaff-laying capability. For up to ten months in every year, three Canberras are detached to Cyprus and Kinloss.

No 360 Squadron was formed at RAF Watton in April 1966 and began to receive its specialised ECM training Canberra T17s eight months later. The squadron moved to Cottesmore in April 1969 and to its current base at Wyton on 5 August 1975. As well as being the only operator of this Canberra mark, it is also unique in being the largest electronic warfare training squadron in NATO and the only joint Royal Air Force/Royal Navy squadron. The squadron is manned in the ratio of 75% RAF and 25% RN personnel; in keeping with the manning ratio, every

fourth Commanding Officer is a naval officer.

The T17 has a distinctive rounded radome nose with four bulges to accommodate various antennae. There are also tail, fuselage and other small aerials. The tip tanks can be replaced by chaff dispensers when required. Six of the twelve T17s have been modified with an upgraded EW and navigation suite to T17A standard. The main external difference is the addition of underwing blade aerials outboard of the engines. During upgrading, the colour scheme of the T17As was changed to hemp, a colour that is gradually working its way through the whole fleet.

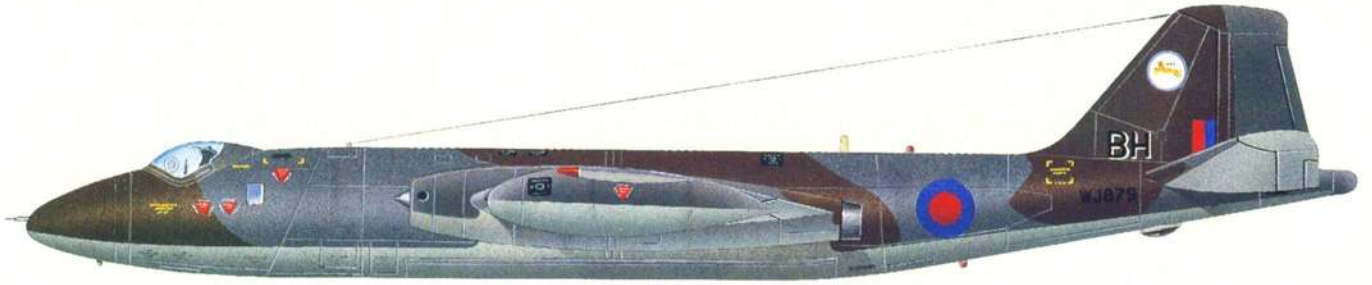
The T17 crew comprises pilot, navigator and an electronic warfare officer who is responsible for the jamming of radar or communications as appropriate when

tasked against the air defence assets of the RAF, RN, Army or NATO in exercise or routine training. The squadron has a regular commitment to weekly exercises for the Flag Officer Sea Training off Portland, as well as regular detachments on NATO exercises from North Norway to Southern Europe. In addition, the squadron is visited by NATO electronic warfare units for joint exercises. The oldest airworthy Canberra, WD955, first flown on 14 November 1951 as a B2 but now a T17A, is still operated by the squadron. Despite its age, WD955's total airframe hours are only 6500.

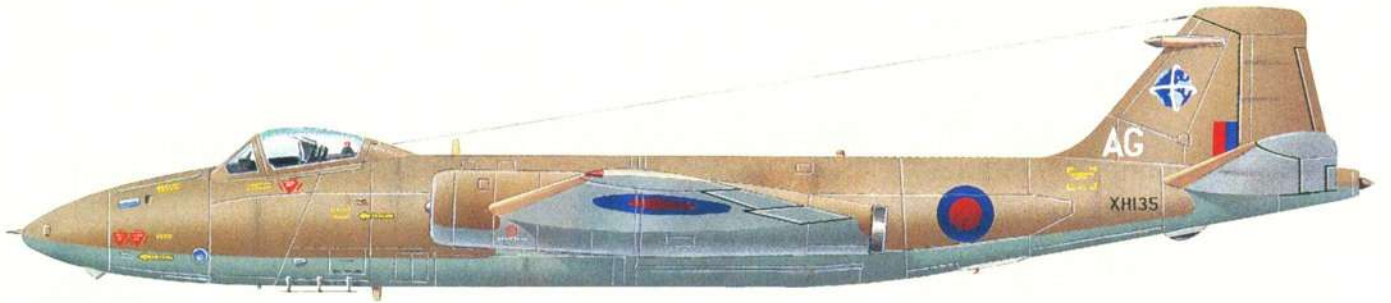
Cartridge start up for the RR Avons in readiness for another sortie. Edwin A. Shackleton



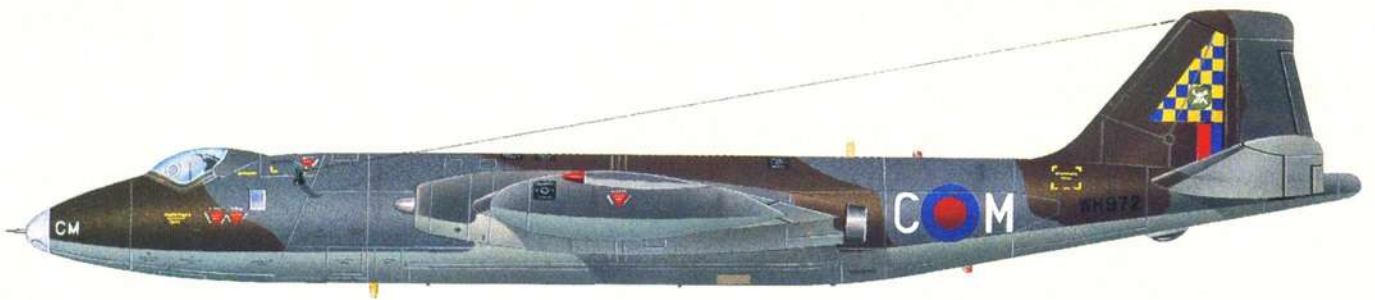
Wyton's Canberras 1989



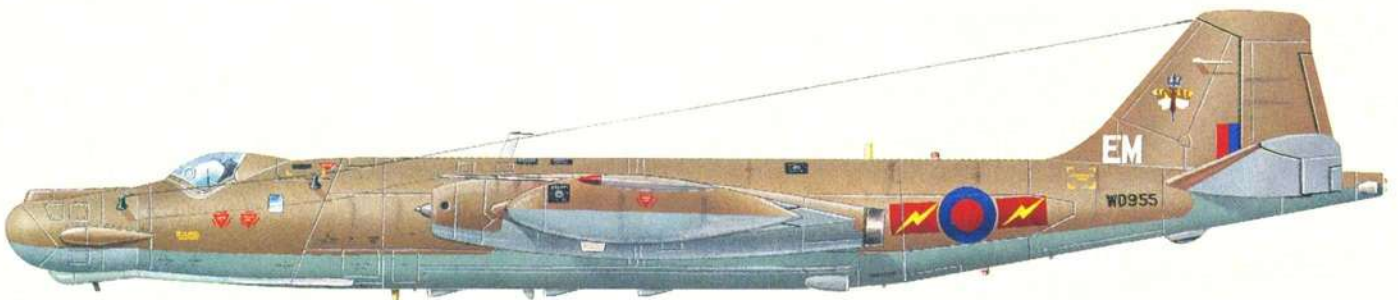
Canberra T4 No 231 OCU



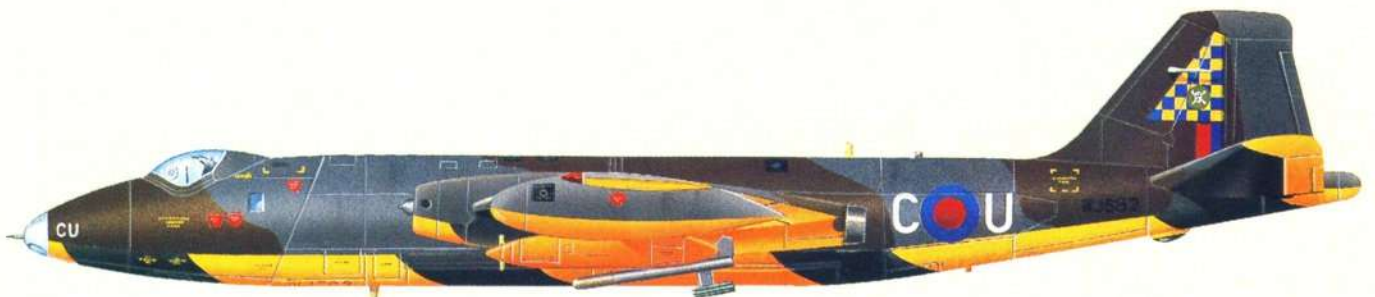
Canberra PR9 No 1 PRU



Canberra E15 No 100 Squadron



Canberra T17A No 360 Squadron



Canberra TT18 No 100 Squadron

Original drawings by Mike Keep.

No 1 Photographic Reconnaissance Unit was re-formed in 1982 with some of the Canberra PR9s that had previously equipped No 39 Squadron at Wyton. It carries out aerial survey or reconnaissance duties for the Royal Air Force, NATO or on contract to foreign governments. Over the past two years the PRU has surveyed Bermuda, Kenya, Germany and Denmark.

No 231 Operational Conversion Unit is the oldest surviving Canberra unit, having been formed at Bassingbourn in December 1951 and commencing training in May 1952. When the base was handed over to the Army in 1969 the OCU moved first to Cottesmore and then to Marham. Wyton became the home base for No 231 OCU in 1982. Today it uses the Canberra T4, the mark with which the pilot

to a refurbishment programme by British Aerospace at Samlesbury since 1970. There has been some limitation on the flight envelope to extend the aircraft lives, but this had not seriously curtailed the operational capability of the Canberra. A recording fatigue meter is fitted in the starboard undercarriage bay from which records are plotted to monitor fatigue life for each individual airframe.

The unit's ground crews check their aircraft after each flight, acting on any faults or snags reported by the pilots, refuelling the aircraft, topping up hydraulic tanks and the oxygen systems, checking for leaks, integrity of panels and damage from hail, bird impact or any other external sources.

Routine inspections (primary and primary star) are carried out on each unit, making use of 'single' Canberra hangars where necessary. A night shift from 16.00, overlapping the day shift, covers night flying requirements and any fault clearance for the next day's flying.

The Canberra Servicing Flight handles more extensive inspection and repair requirements. The CSF and the units are able to call on the services of a resident British Aerospace engineer who deals with technical matters relating to the structure. Despite the age of the Canberra, servicing problems are relatively minor. However, operating costs are carefully monitored and if damage is incurred the cost effectiveness of returning the damaged aircraft to service is carefully analysed before a decision is taken.

All of the Wyton ground and flying operations are the overall responsibility of the Station Commander, Group Captain R. McKendrick covering the local Canberra operations and the intricate problems of the many detachments (60 different bases were visited in 1988) as well as No 51 Squadron. An additional activity in 1989 is the celebration of the 40th anniversary of the Canberra's first flight on 13 May.

The Canberra made its mark as the RAF's first jet bomber; it has become one of the service's most versatile aircraft and perhaps it will be its oldest servant. No 100 Squadron is likely to re-equip with Hawks for the target facilities role in the early 90s. However the T17s of No 360 Squadron and the PR9s of No 1 PRU are likely to stay in service for much longer and it is not inconceivable that the Canberra could reach its 50th birthday in May 1999!

Whatever the final record may be, it is a fine testimony to the design of Teddy Petter and the original team at English Electric. To quote a 40th Anniversary tribute by Roland Beamont "The successes of the Canberra were clearly due to four main factors — performance, reliability, maintainability and superb handling qualities, leading to great flexibility in operation. Now, after 40 years, the English Electric Canberra has an established place among the 'greats' of aviation history — a fitting tribute to its classically simple construction, brilliant aerodynamics, fine engines and reliable systems".

Below: Canberra PR7 WT519 No 100 Squadron. Crown copyright



Above: Canberra E15 WH981 No 100 Squadron. David Oliver

Below: Canberra PR9 No 1 PRU. Crown Copyright

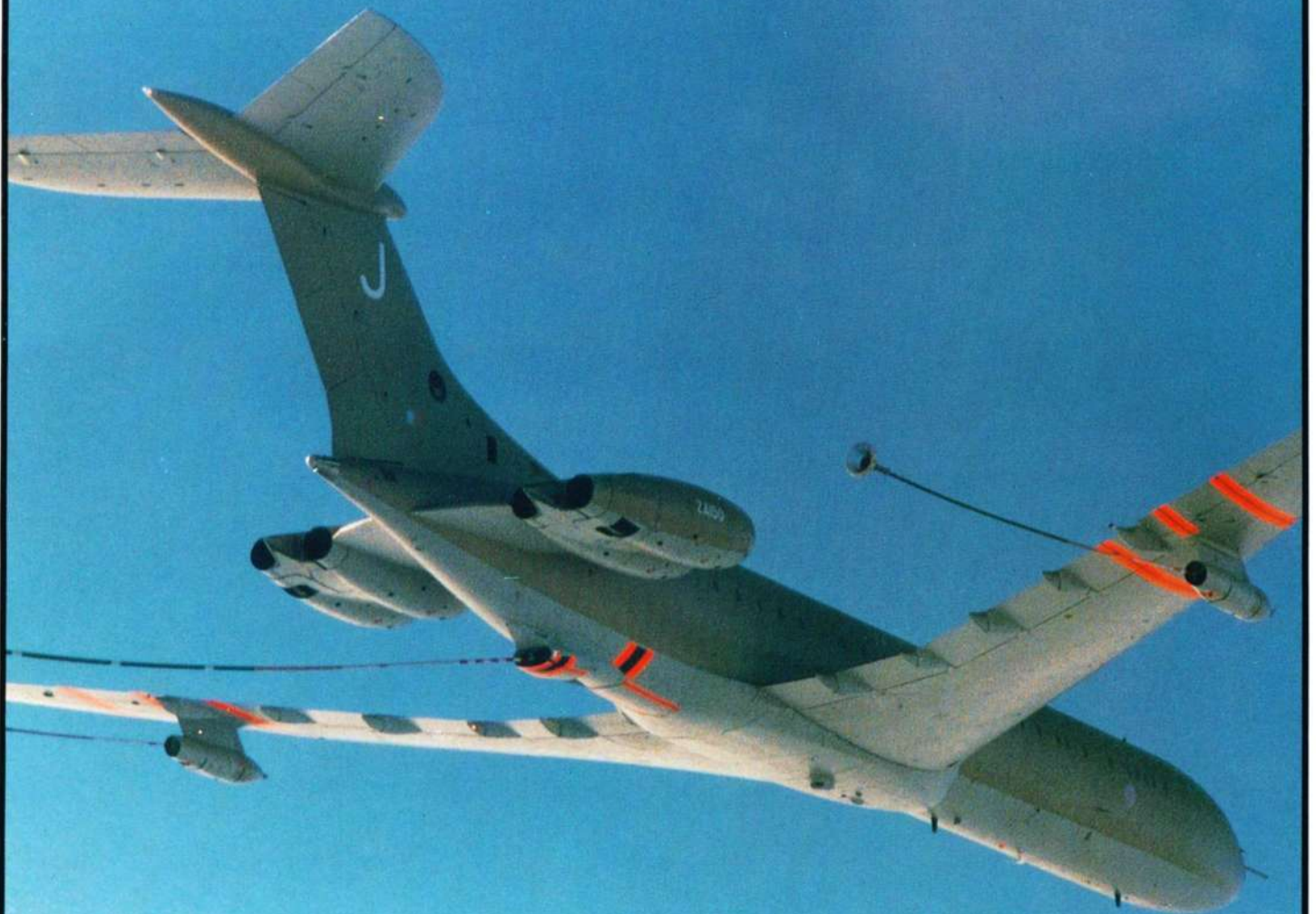


conversion training commenced over 37 years ago. During this time it has trained over 8,000 Canberra crews from 16 countries. The specialist trainer version is backed up by a pair of B2s.

It is interesting to note that of the Wyton based Canberras, nearly half were built by English Electric, a quarter by Shorts, and the remainder by Avro and Handley Page. The four units are spread around RAF Wyton at separate dispersals, each having its own ground handling crews, who normally commence a day shift at 06.00, ready to prepare the first wave of Canberras for the early sorties. All except the PR9s are parked outside with covers over the upper fuselage hatches to prevent possible water ingress while normal engine blanks and pitot covers are fitted.

All of the Canberra fleet, except the more recent PR9s, have been subjected

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1939

THE RAF GOES TO WAR

John D.R. Rawlings

As the New Year was toasted in on 1 January 1939 there was an uncanny, almost unreal, feeling of ambivalence within Britain. Only nine weeks previously Europe had come to the brink of an all-out war and stepped back with a profound sense of relief. The British Prime Minister, Neville Chamberlain, had flown back from his meeting with Adolf Hitler in Germany and declared that he had established 'peace in our time'. We had all expected that at any minute the air raid sirens would sound and a deluge of high explosives would descend on our homes, so the relief was great. Christmas 1938 had been celebrated with thanks-giving but yet . . .

But yet in reality nothing had changed. Hitler was still calling for more and more 'lebensraum' and the British and French governments were still accelerating the expansion of the armed forces as though Armageddon was only hours away. At school we all had to try on our new gas masks to check their fitting and the most common acronym of those days was ARP (Air Raid Precautions); fathers and mothers joined the ARP and became Air Raid Wardens, and were issued with tin hats with W painted on them and highly superior gas masks. Not much peace in our time.

For the Royal Air Force the Munich Agreement of 1938 had come as an immense relief since at that time it was in no way ready to face an all-out war with Germany's *Luftwaffe*. The expansion plans were in full swing but most of the squadrons were still flying obsolescent types; there were only three squadrons operational on Hurricanes and none with Spitfires.

By 1 January 1939 things were improving fast, such as the growing momentum of modern aircraft flowing from the production lines. On that date the front-line of the RAF, as shown by its units, stood



Above: Fairey Battles of No 105 Squadron flying from RAF Harwell in 1939.

Below: The Hawker Hart Trainer was used by 27 RAF Reserve Flying Schools all over the country. This aircraft was operated by No 10 FTS at Tern Hill.



Right: The RAF on display to MPs at Northolt in 1939. In the line-up are Hurricanes (111 Sqn), Spitfires (74 Sqn), Gladiators (3 Sqn), Gauntlet (17 Sqn), Hampdens (144 Sqn), Whitleys (58 Sqn), Wellingtons (38 Sqn), Blenheim IVs (53 Sqn) and a trio of Battles.

at 135 squadrons, slightly ahead of the expansion programme planned in 1936. The force was divided into Bomber and Fighter Commands of which Bomber Command had 74 squadrons (plus three R. Aux AF units). For equipment, the Fairey Battle and Bristol Blenheim I were well-established in light bomber service but the medium bomber squadrons were still relying on slower types such as the Handley Page Harrow — which was obsolescent — and the Tiger-engined Armstrong Whitworth Whitley. Handley Page Hampdens had just entered service with the two Waddington squadrons but were not yet operational. The most promising bomber of the time, the Vickers Wellington, had just reached No 38 Squadron at Marham but was not yet operational.

Fighter Command had 27 squadrons (plus 11 R. Aux AF units) but here again there was great reliance on biplane fighters such as the Gloster Gauntlet and Gladiator. Hurricanes were now flowing out from Brooklands in good numbers but as 1939 dawned there was only one squadron at Tangmere, two at Biggin Hill, two at North Weald, one at Digby, one at Northolt and two at Debden with the type. As for Spitfire squadrons, there were two at Duxford, plus one at Catterick and that was all. As a stop-gap some of the fighter squadrons were receiving Blenheim I bombers modified for fighting, with a tray of four Browning machine-guns under the bomb bay, to try and give the units a higher performance than the Gauntlets could give, and longer range.

Army Co-operation units totalled 12 squadrons, mostly biplanes, and for reconnaissance there were 17 squadrons, using flying-boat biplanes in what was to become Coastal Command. For naval offensive duties there were four squadrons of Vickers Vildebeest torpedo-bombers (two in the UK and two in Singapore) and with three other Auxiliary units this made up the total force.

It was just as well that the immediate threat was in Europe, for that part of the RAF's fleet spread across the then British Empire, consisted almost entirely of the same Bedouin-bashing biplanes that the service had used so effectively in keeping the peace in the 1920's and 30's. During 1939 this balance began to change.

It was not just in numbers of new types that the race was on in the final months of peace in 1939. Many of the tactics and much of the equipment used operationally by the RAF was still working on guidelines drawn from the air fighting of World War I. With the performance of the modern monoplane much of this needed revising and the scientists connected with the aircraft industry were hard at work to meet the need. At the Royal Aircraft Establishment at Farnborough, for example, 24 aircraft were being used for the development of advanced



aerodynamic devices, and a similar number were being used in radio and radio direction finding (RDF) developments as well as other secret projects. 20 aircraft were involved on armament trials and such bizarre ideas as towing aerial mines to blow up other aircraft, while over 30 were involved in engine and airscrew developments.

Most successful in the immediate years ahead were to be the experiments with radar, or RDF as it was then known. It was given this title so as to appear innocuous to any prying eyes and ears. The first ground radar station set up in 1937 was found to be very successful and the effort in 1939 was to develop and perfect techniques. Many possibilities were explored, not only of ground installed radar, but of airborne radar installations, primarily for air defence and to see what other aspects of operations would be opened up with suitable radar applications.

Not all of the bright ideas being hotly pursued at the time were good. 1939 saw

Boulton Paul working frantically to get the Defiant two-seat fighter production lines going. This aircraft was based on 1914-18 thinking, arising out of the success of the 1917-vintage Bristol Fighter in air fighting. But tactics had moved on and when the Defiant finally entered operations in 1940 it was found to be an easy target for enemy fighters.

Through the spring and early summer of 1939 the Royal Air Force applied itself to preparing for war in every sphere. Aircraft, airfields, buildings and vehicles were all camouflaged. Even the trainers, painted bright yellow for collision avoidance, had the tops of their wings and fuselages repainted in drab colours so that while on the ground, they would not be so conspicuous to prying reconnaissance eyes.

A new generation of bombers, bigger and heavier than the Wellington, had already been planned. Work moved quickly on these during 1939 and the first prototype of the Short B12/36 four-engined heavyweight was ready to fly in the early



Far left (top): A Finningley based Armstrong Whitworth Whitley of No 7 Squadron still lacking gun turrets, with war imminent.

Far left (bottom): These Wellington 1s of No 9 Squadron based at Marham took part in the first daylight bombing raids of the war.

Left: Lockheed Hudsons entered service in 1939 for maritime duties.

and do their bit for the RAF in a wide variety of tasks, freeing men for more warlike duties. These young women quickly earned respect from the RAF personnel for their skills and dedication; many of them gave their lives when serving on stations in the Battle of Britain. Although it was only formed at the end of June, by the outbreak of war just over two months later the WAAF numbered 8,000 women and was serving at RAF Stations all over the UK.

By June it was abundantly clear to all but the most obtuse that war could not be far away. Hitler was already making noises about Danzig, with a view to using it as an excuse for occupying Poland, so the British and French Governments worked together to prepare for the inevitable. This resulted in preparations for joint operations, the first evidence being seen in a fortnight of Air Exercises in the middle of July. Bomber Command sent large formations of bombers on simulated raids over Central and Southern France (over 200 aircraft were involved) and at the same time the French Air Force made formation sorties over Southern England. For the next month tension grew as diplomats looked at every possibility of giving Hitler an opportunity to climb down from his threat against Poland.

On 24 August the situation had deteriorated so much that it was deemed wise to declare General Mobilisation. The Royal Air Force went onto a war footing in the United Kingdom. All of the operational squadrons moved to their war stations and those deemed to be non-operational were set up on an operational training basis, the forerunners of the Operational Training Units. Already No 48 Squadron at Eastchurch, equipped with Avro Ansons, had been flying quasi-operational reconnaissance patrols over the North Sea, keeping a check on the movement of German shipping. This was now intensified and other Anson squadrons around the coast joined in to give a comprehensive picture of all possible enemy shipping ready for the declaration of hostilities. By the end of the month plans had been finalised for the deployment of two distinct organisations to go to France as part of the RAF's advanced guard. On 1 September the RAF Reserve and the RAFVR were called up for permanent service and the Auxiliary Air Force was 'embodied', to give it its official term. From that moment it remained on active service for the next six years.

The next day (2 September) the situation had so deteriorated that it was felt necessary to move the two organisations into position in France. One of these was a purely offensive force — the Advanced Air Striking Force under Air Vice-Marshal Peter Playfair — consisting of ten squadrons of Fairey Battles and two squadrons of Hurricanes. The other organisation was the Air Component of the



summer. The first Short Stirling, took off from Rochester on 14 May 1939 and performed well in the air, but on landing a main wheel brake seized and in the resultant ground loop the undercarriage collapsed and the aircraft was too badly damaged to repair. This was a major setback as it was the most advanced of all the new bombers at this time.

By May 1939 it was becoming increasingly clear that there would be no 'peace in our time' as Chamberlain had forecast. On 20 May the RAF opened 60 of its Stations to the public for the annual Empire Air Day. Such was the interest of the British public in those ominous days that almost a million visitors entered the gates to see for themselves what 'their air force' was like. Naturally, most interest was centered on the inner ring of London's defence airfields, as the press made it quite plain that as soon as war broke out, London would be subjected to a horrifying assault from vast numbers of the *Luftwaffe's* Heinkel He 111s and Dornier Do 17s.

Generally the picture was reassuring: Northolt presented Treble-One Squadron with its very operational Hurricanes; North Weald had two operational squadrons of Hurricanes, Nos 56 and 151; Hornchurch had three squadrons of Spitfires (Nos 54, 65 and 74), although they were not yet operational and Biggin Hill presented two squadrons of Hurricanes (Nos 32 and 79) which were well on their way to being operational. In contrast, Kenley provided the spectators with one regular squadron of Gloster Gauntlets (No 17), three Gladiators and one Hurricane of No 3 Squadron, and No 615 Auxiliary Air Force Squadron, also with Gauntlets! This, however, bears comparison, in terms of numbers, with today's defence of London, which comprises two squadrons of Phantoms at Wattisham, although the threat is, of course, very different.

The summer of 1939 saw a most significant development in the RAF with the formation, on 28 June, of the Women's Auxiliary Air Force (the WAAFs). This gave an opportunity for young women to join up



Above: The heavyweight Short Stirling bomber shows its long bomb-bay.

British Expeditionary Force, under Air Vice Marshal C.H.B Blount. It comprised four squadrons of Westland Lysanders for Army-Co-operation, four squadrons of Blenheim bomber/reconnaissance aircraft, two squadrons of Hawker Hurricanes and two of Gloster Gladiators.

At 11am on 3 September, having received no reply from Hitler to the ultimatum to withdraw from his invasion of Poland, the Prime Minister declared war on Germany. Within minutes the air raid sirens wailed over London. Londoners took shelter, saying to one another 'This is it', but after half an hour in the shelters the 'all clear' sounded. What had been taken for a German raid was an unidentified radar plot which turned out to be a French communications aircraft. The whole defence system continued to brace itself for the first real raid: the dreaded *blitzkrieg*. It never came. In the meantime, the patrols by Coastal Command were now set up on a war footing with the Ansons covering the nearby waters while the flying-boat squadrons went far out into the Atlantic and up to the Baltic and north of Norway, particularly looking for U-Boat passages.

Coincidental with the first wailing of London's sirens in anger a Blenheim IV of No 139 Squadron piloted by F/O A.McPherson, took off from RAF Wyton, and flew across to Wilhelmshaven above 20,000 ft to make a reconnaissance

of the German Fleet. The mission was accomplished without any opposition and 4½ hours later the aircraft landed safely at Wyton with photographs of the fleet. As these were being examined ten Whitleys of Nos 51 and 58 Squadrons at Linton-on-Ouse in Yorkshire, were loaded up with pamphlets. They set off that night to drop them over the Ruhr, Hamburg and Bremen, the precursor of a continuing series of pamphlet raids all through the winter which were code-named Operation *Nickel*.

Whilst the effect on the German population was negligible, the flights enabled Bomber Command to assess its own ability to mount night raids, to navigate over Germany at night and to probe the heartland of Germany's defences. What it learnt was disconcerting, to say nothing of the discomfort of the crews who suffered intense cold through the long winter nights. The Command found to its consternation that its crews' ability to navigate over a blacked-out country by night was so lamentable that, when night raids began in earnest, there was no guarantee of reaching the target.

In the meantime Bomber Command operated by day, pursuing Trenchard's belief that the best form of defence is attack. On 4 September a formation of Blenheim IVs from Wattisham (Nos 107 and 110 Squadrons), together with five No 139 Squadron Blenheims from Wyton, flew through terrible weather conditions to Wilhelmshaven, where they attacked units of the German Fleet in a low-level bombing raid. No 107 lost one aircraft, No 110 lost

four and the raid had achieved little, for the Fleet put to sea soon after. At the same time six Wellingtons from No 9 Squadron at Honington, together with eight from No 149 Squadron at Mildenhall, flew through the same atrocious conditions to Brunsbüttel where they attacked shipping. Due to the bad weather only one hit was claimed but two Wellingtons were lost. So, within the first 36 hours of war, Bomber Command had flexed its muscles and begun to learn important lessons.

In France the AASF began probing by flying reconnaissance patrols over Germany to about 20 miles behind the enemy lines. These continued on a regular basis until the end of September, when five Fairey Battles of No 150 Squadron were engaged by Messerschmitt Bf 109Es. All five were destroyed, although one did manage to return to French territory. — This disaster sounded the death knell of the Fairey Battle as an operational bomber. Unfortunately it also wrote the death warrants of many Battle crews, as it had not been replaced before the fighting broke out in earnest in 1940. With no action from the German forces on the Continent, it remained 'all quiet on the Western Front'.

It was not so quiet at sea. Despite the many Coastal Command patrols and Bomber Command reconnaissance flights, U-Boats were beginning to make their mark on the shipping as it plodded its way to and fro across the Atlantic. In the middle of the ocean, Coastal Command could do little to combat the menace, with few



aircraft and great expanses of water. But it made a valiant attempt to assist. On 18 September two Sunderlands on patrol — one from Pembroke Dock in Wales, the other from Sullom Voe in the Shetland Isles — picked up distress signals from the SS *Kensington Court* which had been torpedoed off the Western Approaches. With great presence of mind the two Sunderlands alighted on the sea and picked up the entire crew of 34, and returned them to England. Unfortunately, this turned out to be the exception rather than the rule, and it was not until January 1940 that a Sunderland managed to sink a U-Boat. To cope with Coastal Command's shortage of aircraft 200 Lockheed Hudsons had been ordered from America and these came into use in September 1939, taking over from the Ansons which were used mainly over the North Sea, Baltic and up the Norwegian Coast on anti-shiping patrols.

A new menace in the seas soon came to the forefront of operations. The Germans had started sowing mines, by aircraft at night, in the seaways around Britain. These were exploded by magnetic fields set up by the ships passing over them, and to eliminate such mines vessels had to be hurriedly fitted with magnetic rings around their hulls. While this was in progress a number of the original Wellington 1s were sent to Rollasons at Croydon Airport, where they were fitted with huge magnetic rings attached to nose, tail and underwing points. They were flown heroically and dangerously at extremely low level around

the UK coasts, exploding as many mines as they could fly over. The few Wellingtons employed rendered harmless one-eighth of all the mines during the period in which it was necessary to send ships to sea unprotected against these devices.

It had been assumed that, on the outbreak of war, Fighter Command would be the most hard-pressed of all the commands. Experience proved otherwise. Just as the first tentative British actions were against the German Fleet, so the *Luftwaffe* acted similarly — but not until halfway through October when nine Junkers 88s escorted by a Heinkel He111 for reconnaissance, made an attack on the Fleet at Rosyth in the Forth Estuary. Fighter Command was ready and put up the two Scottish auxiliary fighter units of the day, Nos 602 *Glasgow* and 603 *Edinburgh* Squadrons. The latter downed the Heinkel He 111 and the former shot down one of the Ju 88s, thus scoring first blood for Fighter Command in World War 2. Ever since, the two squadrons have disputed which was actually the first one brought down! A further attack was made the next day, this time on Scapa Flow, but most of the Fleet were at sea and the only ship damaged was an ancient target ship while the *Luftwaffe* lost two enemy aircraft to anti-aircraft guns.

Obviously the *Luftwaffe* did not find it any easier to attack shipping than the RAF. The latter made another attempt on 3 December when two dozen Wellingtons from Marham and Mildenhall attacked the German Fleet off Heligoland. This time no

Main picture: A section of No 43 Squadron Hurricane 1s coming in to land at Tangmere in August 1939.

Above left: *Pride of Coastal Command*, the new Short Sunderland flying boat entered service in 1939.

Above right: Spitfire 1s of No 65 Squadron flying from Hornchurch in 1939.

Wellingtons were lost but only one ship, a minesweeper, was sunk. An enemy fighter was also shot down. This encouraged Bomber Command to make further daylight attacks and nine days later No 99 Squadron, operating from Newmarket, had its baptism of fire. A dozen aircraft went to Wilhelmshaven, but were severely mauled by German fighters and AA fire: only six returned. Four days later another force of 22 Wellingtons attacked the same target. Such was the intensity of the defence that no bombs could be dropped on target and, ten Wellingtons were shot down; five more were lost on the return journey. This convinced the RAF that daylight raids were too vulnerable.

And so 1939 drew to a close. It seemed by the end to be a decade away from its opening. The RAF had been bloodied but, because of the small-scale aerial fighting, had begun to learn some valuable lessons about its defects. It still had the early months of 1940 to find remedies to its problems and this now became the priority. The forthcoming Battle of Britain was looming.

THE OLD BRIGADE...

BUT STILL IN SERVICE

GLADIATOR

109 - who Me?

1939

The RAF 50 years ago

SHORT-NOSED BLENHEIM

GET SOME IN!

I'LL PUT BRITAIN FIRST!

I'M GOING TO DROP LITTER ALL OVER GERMANY

WHITLEY

WALRUS

FAIREY BATTLE - a "high-speed" bomber

WHY DO THEY CALL ME A FLYING-SUITCASE?

NICE PEOPLE SAY I LOOK MORE LIKE A SEAGULL ...

ANNIE, GET YOUR GUN

AND SOMETIMES A TADPOLE ...

SOMETIMES I FEEL LIKE A CAMEL

HAMPDEN

LERWICK

BIG BOAT

DEFIANT

WELLINGTON

OTHERWISE KNOWN AS WIMPY

SUNDERLAND

BIGGER BOAT

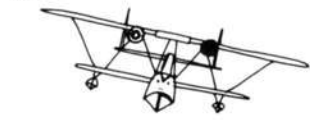
THE MISSING LINK...

OXFORD - OR 'OXBOX'

Jolly good boating weather

MCMXXXIX

NOW PUPILS CAN MAKE DOUBLE MISTAKES



LONDON AND STRANRAER

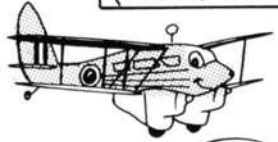
MAGISTER

I HAVE CONTROL - I THINK ...



LYSANDER

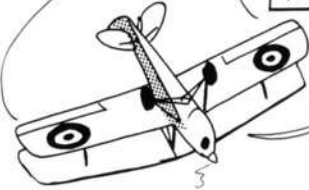
(ANNO) DOMINIE



LAST WEEK I WAS A DRAGON RAPIDE

TIGER MOTH

YOU HAVE CONTROL - I HOPE ...



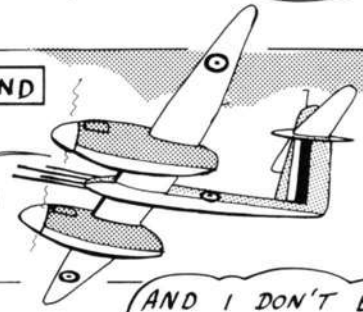
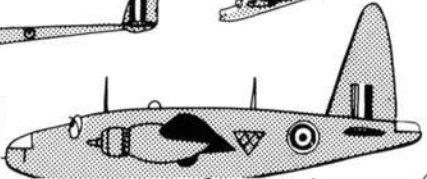
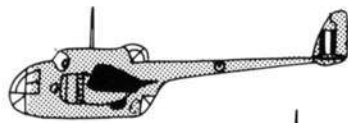
LIZZIE-THE ORIGINAL HARRIER

WHIRLWIND

THEY CALL ME 'CRIKEY'

AUGUST: ANNUAL WAR EXERCISES

Westlands (Goodies) Eastlands (Baddies)



AND I DON'T EVEN HAVE A TV LICENCE

MASTER

I'LL TRAIN THE WHIZZ-KIDS

I'VE GOT A GREENHOUSE EXTENSION

PROCTOR

ACTUALLY, I PREFER TO BE CALLED A VEGA-GULL

LONG-NOSED BLENHEIM

SOB, MY MUM WANTED ME TO BE A DIVE-BOMBER

ANSON, RADIO LOCATION EXPERIMENTS

HENLEY

SPITFIRE

I'M ONLY THE FIRST OF THE FEW

CHAMBERLAIN'S LOCKHEED 14 ZAPPED BY LUFTWAFFE AT MUNICH (JOKE)

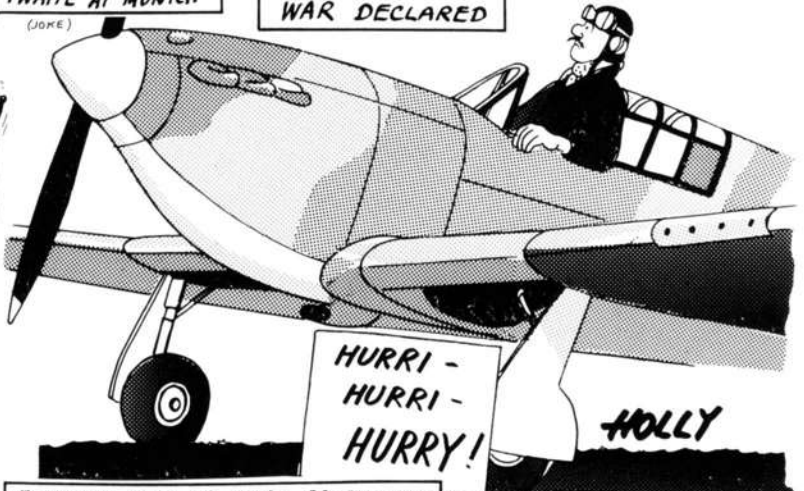
SEPTEMBER 3 WAR DECLARED

AUGUST 26 - READINESS 'D'

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AIRMEN USE WET MUD FOR CAMOUFLAGE



HURRI - HURRI - HURRY!

HOLLY

FIGHTERS NOW IN MASS PRODUCTION



KEEPING THE TORNADO FLYING

Peter R. March

After a 12-year development programme, the first of the RAF's initial order for 220 Panavia Tornado IDS ultra low-level attack aircraft was handed over in July 1980. The Tri-National Tornado Training Establishment (TTTE) at RAF Cottesmore was formed early in 1981 and the build-up of the operational strike/attack force quickly gathered momentum. By 1 November 1985, when RAF Germany's No 14 Squadron, equipped with the Tornado GR1, a total of nine squadrons were operational (Nos 9, 14, 17 and 31 Sqns at RAF Bruggen; Nos 15, 16 and 20 Sqns at RAF Laarbruch; Nos 27 and 617 Sqns at RAF Marham) as well as the TTTE and the Tornado Weapons Conversion Unit (TWCU/No 45 Sqn) at RAF Honington. The RAF's Tornado IDS programme was then put 'on hold' for three years.

The last 20 IDS aircraft of the initial production order were diverted to Saudi Arabia in 1986/87, and are in service with No 7 Squadron RSAF. A further nine attrition replacement GR1s were ordered by the RAF in September 1985. The Defence Procurement minister announced another order for 26 Tornado GR1s last year, "To sustain the RAF's Tornado force into the next century". During the latter part of 1988 No 2 Squadron, RAF Germany's tactical reconnaissance Jaguar unit at Laarbruch, began to re-equip with specially modified Tornado GR1As. These aircraft have sensor windows along the fuselage and incorporate new equipment for the specialist role. No 2 Squadron was fully established for the attack/reconnaissance task early this year and will be working up to full operational capability in due course. The final RAF Tornado IDS unit, to be based at RAF

Honington alongside the TWCU/No 45 Sqn, is in the early stages of formation. No 13 Squadron will eventually take over the tactical reconnaissance role from No 41 Squadron's Jaguar GR1As, once the new build GR1As have been delivered.

With nearly 200 Tornado GR1s in service at three UK bases, two in West Germany and one in Canada (Goose Bay), the RAF has had a huge engineering and support task, both to introduce the aircraft and to keep them fully operational. Never learning from past experience, the arrival of the new aircraft was often followed after unacceptably long delays, by the delivery of handbooks, spares, ground equipment, test sets and the completion of new buildings. Each of the main stations required the training of 800 personnel for the myriad of tasks to keep the Tornado flying. This was done effectively and to a high standard despite the inadequacies of training aids and reference material, while still maintaining the squadrons' existing operational commitments. The main difficulties clearly arose in terms of providing the equipment, spares and detailed technical know-how, to allow the stations' engineering wing and the flying squadrons to tackle the inevitable introductory problems with such a complex new aircraft.

The overall maintenance policy for the Tornado has changed, as the former Royal Air Force Chief Engineer, Air Marshal Sir William Richardson explained recently: "Clearly we want to do as little work as possible commensurate with operational effectiveness and flight safety. In an ideal world we would only disturb a system 'on fault', but experience has shown that preventive maintenance is cost effective in

reducing failures. The original specification laid down that there should be no scheduled maintenance at periods of less than 300 flying hours and also called for sufficient self-check capability to reduce the need for test equipment at the aircraft to a bare minimum. However, this planned maintenance pattern has now been stretched and currently a Minor is carried out every 400 hours and a Major at 1600 hours, after three Minors have been performed; the cycle is then repeated. Generally this maintenance is of a mechanical nature while on the electrical and avionics front, with few exceptions, a genuine 'on condition' maintenance policy can be pursued — that is, we just mend the bits that fail".

"While the Minors and Majors form the basis of the schedule, in practice it has been found necessary to have planned intermediate maintenance every 100 hours — the Primary. These are manageable packets of work, which include special instructions which have resulted from failures or problems found in service and modifications which are minor in work content but significant in terms of either operational or safety benefits. These have come thick and fast and have formed an appreciable part of the 5,000 plus different modifications now embodied into the various build standards of the Tornado GR1."

Heading up the engineering authority for the RAF's Tornados at the Ministry of Defence is the Directorate of Tornado Engineering and Supply. The Directorate is responsible for all aspects of fleet management including airworthiness, special instructions, modifications, repair, overhaul and essential liaison with the

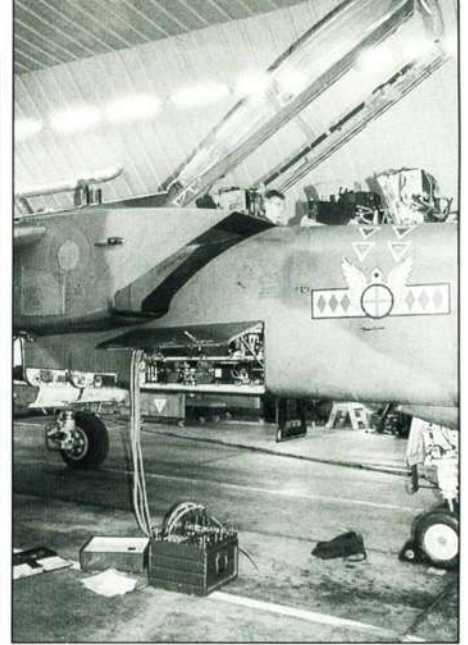
NATO MRCA Management Agency (NAMMA), Panavia, British Aerospace and the many contractors. It works through the Tornado sections at the Command HQs to the operating stations and the squadrons.

To see how the RAF's engineering resources are used to keep the Tornado flying we have looked at No 14 Squadron at RAF Bruggen and followed some of the squadron's aircraft through the four maintenance and repair levels – first line with the squadron; second line at station level; and third/fourth line at RAF St Athan. No 14 Squadron (OC Wing Commander R. Vaughan Morris) has been with RAF Germany since 1 April 1946 and at Bruggen since 30 June 1970. It operated Phantom FGR2s from June 1970 until November 1975 and Jaguars for the next ten years before being equipped with Tornado GR1s. Senior Engineering Officer Squadron Leader Nigel Bairsto and his team are responsible, under the RAF's semi-autonomous squadron maintenance policy, for the day to day operation of No 14's aircraft. This includes 'flight-line' handling, fault rectification and Primary maintenance.

The term 'flight-line' is a misnomer as the aircraft are each housed in a Hardened Aircraft Shelter (HAS), on a dispersed site with up to 200 yards between each HAS. This means that there is a good deal of travelling around the site for routine tasks and each HAS must be provided with its own set of support equipment. Early

shortages of these items have now largely been overcome. One of the insuperable problems, however, is the lack of space in the HASs at Bruggen, which were originally designed and built for the smaller Jaguar.

After taxiing to the HAS in the wooded perimeter, each No 14 Squadron Tornado is winched backwards into its individual shelter, before the crew dismount. At the Squadron Operations Centre the pilot reports any identified aircraft faults to the Rectification Controller who brings in appropriate Trade Managers or their representatives to discuss them with the pilot. These avionics, weapons, airframe, electrical and propulsion specialists complete their diagnosis of the problem and report back to Rectification Control with an estimate of the time needed to clear the fault. Priorities are then set and the information passed to the Squadron Logistics and Operations Cell. The repair might simply involve a line replaceable unit (LRU) such as an electronic 'black box' or small component, or the adjustment of an instrument or control. The defective unit will then be sent to the appropriate section of Bruggen's Engineering Wing for repair. Hopefully a replacement unit is available 'off the shelf'. However, the Tornado spares position is still far from adequate. To quote the RAF's Chief Engineer "The problem of spares is still by far the the greatest day-to-day headache in supporting the Tornado fleet". This is echoed right down the line at every level.



Many of the Tornado's systems are readily tested in the HAS using plug-in ground test boxes.

Peter R. March

The moment an aircraft is taken into Primary or Minor maintenance at Bruggen it immediately becomes a source of key spares. This aircraft is 'robbed' of items that are not readily available at the squadron or from the station's store, to keep other Tornados flying.

The system of LRUs and the On-Board Checkout and Monitoring System (OCAMS) are important keys to the

Tornado GR1 'Bravo-Delta' returning to the HAS after a training exercise.

Andrew March



There is little room to spare with a Tornado in the HAS. A drop-tank rack occupies the right hand corner.

As the aircraft is winched back into the HAS, an SAC guides the nose wheel arm.

Peter R. March



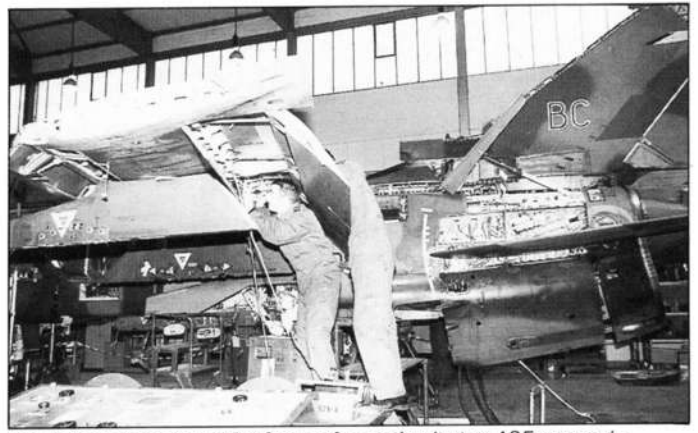
After engine testing, the GTB is disconnected but the intake safety guards remain in position.

Peter R. March





'Bravo-Charlie' undergoing a Minor service with the ASF at Bruggen.
Peter R. March

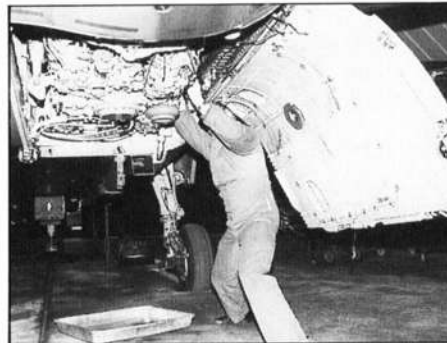


The Tornado's flaps are the focus of attention by two ASF corporals.
Peter R. March

Tornado's maintainability at squadron level. OCAMS helps to pinpoint and record aircraft systems faults while airborne and the groundcrew can pick them up from the Central Maintenance Panel after the flight. Some 45% of the Tornado's surface is covered by access panels and 90% of the fuselage LRUs are at normal working height, requiring no special equipment to get at them, while nearly all of the likely fault locations, replenishment and sampling points are also accessible from the ground. The great majority of the avionic LRUs can be dealt with by one person. Ground test equipment, which remains in crucially short supply, can be plugged into the aircraft's systems through a single fuselage point and a full check made on a quick view panel.

The squadron's engineering task for the dozen aircraft on strength requires a two-shift system with continuous cover from 08.00 (or earlier) on weekdays through to about 02.00. Each Tornado has to have a Primary check after 100 and 300 flying hours and a slightly more detailed Primary* check at 200 hours, in each maintenance cycle. Although the basic Primary check on flight systems, the two RB199s and an overall inspection could be completed in a couple of shifts, it also involves STIs (Special Technical Instructions), SIs (Servicing Instructions) and the higher priority PWIs (Preliminary Warning Instructions). These check, repair and modification notices extend the Primary service to two or three days and the Primary* to about five days. No 14's SENGQ Sqn Ldr Bairsto tries to plan the scheduling so that there is only Tornado undergoing maintenance in the squadron HAS at any time. Bearing in mind the many detachments, exercises and other operational requirements, as well as unexpected problems with aircraft, this is something of an uphill struggle.

From an engineering standpoint No 14 Squadron, like all of the Tornado units, is not fully self sufficient. It depends on the station's Engineering Wing for some trades, such as wheel and tyre fitters, armament specialists and aircraft painters as well as for the maintenance of ground equipment and motor transport and the supply of many replacement units and parts. At Bruggen the Engineering Wing, which provides second line maintenance and repair, is divided into five squadrons — Mechanical Engineering



Access to the RB199s is facilitated by large drop-down panels. Peter R. March

(Air), ME (Ground), Electrical Engineering, Armament Engineering and Engineering Operations. The ME (Air) Squadron's Aircraft Servicing Flight (ASF) is responsible for scheduled and corrective maintenance and modifications up to Minor level after 400 and 1200 flying hours, with a Minor* at 800 hours, on all of Bruggen's Tornados. Minor scheduled maintenance takes about 25 working days and includes a detailed examination of the aircraft, checking particularly for corrosion and cracks. Any lifed items are replaced and faults not dealt with at first line by the squadron are cleared. All necessary modifications appropriate to second line are incorporated and any structural and skin repairs are effected.

The ASF normally has at least one Tornado from each of Bruggen's four squadrons undergoing Minor scheduled maintenance at any time, along with other aircraft under emergency repair — bird-strike damage being the most usual reason. The ASF's working teams, each comprising eight airframe riggers, normally stay with the aircraft from one squadron. Earlier this year the ASF's 14 Sqn team was providing a Minor* service on Tornado 'Bravo-Charlie'. In addition to the standard inspection, this 28-day program included removal of the wing flaps and slats to check them and to incorporate some essential modifications. As seemed standard practice, BC had been robbed of many replaceable parts just as soon as it arrived at the ASF hangar. By the mid-point it had lost 19 items including wing nibs and flap motors, both of which were in very short supply at that time.

The Tornado's RB199 engines are only removed by the Propulsion Flight at the Minor* if replacement or rectification is

required. The £1.25 million engine is made up of 16 modules, which can all be replaced at second line if necessary. At Bruggen No 431 Maintenance Unit provides a comprehensive facility for RB199 module overhaul and repair, details of which are kept on computer to keep track of individual histories. There is also a sophisticated Uninstalled Engine Running Test Facility to check the powerplant's performance before it goes back into an aircraft.

An electrical engineering team is brought in to deal with specific items during the Minor overhaul. This very often involves replacement of wiring to incorporate modifications which requires the aircraft power supply to be switched off and access to the limited space in the cockpit. Therefore it has to be phased in carefully with the airframe work. The Electrical Engineering Squadron is responsible for the off-aircraft maintenance of the LRUs, a number of which are removed during the Minor for checking, while those with faults are subjected to detailed investigation. The faulty modules are sent on to third or fourth line for repair.

The RAF has two major third line Tornado depots in the UK. RAF Sealand, Clwyd specialises in avionic and electrical components while RAF St Athan, South Glamorgan handles Major maintenance and deep repair and overhaul of mechanical components. It will also become closely involved with the Tornado Mid-Life Update (MLU) which begins in 1992. The Aircraft Engineering Wing at St Athan (Station Commander Air Commodore David French) was originally set up to handle, through No 10 Squadron, nine parallel tracks of Tornados on Major maintenance. These overhauls require, for each Tornado, some 12,425 man-hours over 82 working days, provided by the Squadron's joint RAF and civilian work force together with a comparatively small contribution from a British Aerospace working party. This throughput was by necessity doubled last year, when No 2 Squadron, which had previously been involved with Victor and Buccaneer overhauls, transferred to Tornado maintenance. By 1991 there will be 21 Major tracks at St Athan and with the introduction of 'double shift' working to make more effective use of the resources, the current needs of the Tornado IDS and



The combined Major and 5FI service underway, showing 'before' and 'after' side panels during the 5FI element. RAF St. Athan



Tornado high-lift wing sweep control unit is set up for testing by No 9 Squadron. RAF St. Athan

ADV fleet will be met.

In addition to airframe Majors by the 1600 hours flying mark, St Athan and BAe have been undertaking a second comprehensive programme — the 5FI airframe update. 5FI stands for Fatigue Index 5, in a scale on which 100 represents an arbitrary figure for the Tornado's fatigue lifetime as determined by estimates and static testing. It was decided to subject each aircraft to an in-depth maintenance programme when it reached 5FI. This work, which involves modifications to the side skinning, intakes and undercarriages in particular, commenced in 1986. BAe was contracted to deal with 60 Tornados at Warton, with the remainder of the fleet going to St Athan. BAe works concurrently on six aircraft, taking about 16 weeks to complete the task. At St Athan the modifications on their own take 76 days, involving 3,355 RAF man-hours with a similar contribution from a BAe working party. When the 5FI and Major programmes are combined the work can be completed in 118 days. Once all of the current aircraft have been through the 5FI programme by March 1990, the shorter (23 days) 10FI work will be well under way and plans will be put into effect for the much bigger (100 days) 16FI wings and fuselage programmes.

After arrival at St Athan, No 14 Squadron's Tornado 'Bravo-Golf' is stripped down by the allotted team from No 10 Squadron. Serviceable components are eagerly seized upon to complete aircraft nearing the end of their overhaul. As everywhere else there are always spares shortages at St Athan. After the engines, radar and avionics have been removed, together with many panels, control surfaces, cockpit canopy, seats and parts that are to be modified or replaced, BG is towed across to No 1 Squadron at the Picketston site, the largest painting and finishing facility in the RAF. Here, over a period of six days, the Tornado's acrylic top coat of paint is removed and replaced by a light coat of anti-corrosion yellow primer.

On return to No 10 Squadron the detailed work of the Major overhaul and 5FI modifications get under way, with the RAF and BAe teams working together in a well established routine. Every aircraft is slightly different and throws up its own unique problems, the solutions to which are recorded centrally on computer. At the

same time the mechanical components have gone elsewhere for repair and overhaul. An increasing number of these remain at St Athan where the extensive engineering and workshop facilities coupled with a highly skilled civilian and service workforce, are enabling the RAF to move rapidly towards a high level of self-sufficiency. It has taken longer, Air Commodore French admits, to establish these facilities, largely because of the reluctance of manufacturers to make detailed repair information available. This is now being overcome and some of the long delays in supplying repaired or replacement parts, particularly by overseas companies, is being offset by 'in house' repairs and in some cases manufacture of components in St Athan's workshops. This in turn is saving millions of pounds in capital investment on pipeline spares and is reducing the cost of keeping the Tornado flying, as the following examples illustrate.

No 5 Squadron at St Athan is a 'manufacturing unit producing unique and complex spare parts for both aircraft and ground equipment'. A jig has been developed by the squadron to repair RB199 stage 1 LPC blades, using scrap fans and salvaging blades to replace those damaged. The repaired fan costs approximately £1500 while a replacement from the manufacturer is £20,000, when it is available. Similarly a computer controlled machine has been produced in the workshop to repolish damaged Tornado windscreens, which previously had to be replaced by the manufacturer at a cost of £7000. The effective repair can now be done very quickly at St Athan for one-tenth of the cost of a new one. The last plating shop in the RAF is being put to good use. A Tornado tailplane actuator piston can be salvaged and replated for under £150. A new one costs £1500 from the manufacturer.

No 7 Squadron of the Support Engineering Wing is tasked with the repair of aircraft structural components such as ailerons, flaps, undercarriages and wheels. It is currently manufacturing new Tornado wing nibs and tailplane leading edges, both of which are in short supply. It is the first RAF unit to do third line composite material repairs and manufacture. A Doppler door repair is being effectively done at a cost of £100. A replacement from the original manu-

facturer is billed at £2000. No 7 Squadron's new transparencies bay provides repairs to aircraft canopies and windscreens. Some 23 man-hours of polishing can restore a damaged Tornado side-screen for re-use at a repair cost of under £700 as compared with £3000 for a new one. And so the examples could go on. Nos 8 and 9 Squadrons of the Mechanical Repair and Overhaul Wing which respectively handle the RB199 engines and mechanical components are handling more and more complex testing, repair and manufacturing tasks and are constantly developing new methods to reclaim components that were previously thought fit for scrap.

As the work on 'Bravo-Golf's' Major and 5FI near the conclusion, but before re-

Cost-saving work to restore a Tornado canopy in the Transparencies Bay. RAF St. Athan



In the Structures Bay, No 7 Squadron personnel work on a Tornado wing nib and taileron leading edge repair. RAF St. Athan



assembly of the structural components that had been initially removed, it is returned to the paint shop for respraying. This process takes about eight days. The new polyurethane camouflage is applied using hydraulic airless spraying equipment, in special temperature controlled bays, to the airframe and the separate components such as the flaps. The next major task is to apply some 300 sets of individual lettering and basic markings, using stencils and transfer decals. This does not include the Tornado's unit markings and code letters which are applied when it returns to its home station. As BG is to go back to No 14 Squadron in West Germany, it also has to have an additional 86 German language markings, which takes a further half day to complete.

Returning to No 10 Squadron 'Bravo-Golf' is rapidly re-assembled as the engines, various airframe components, avionics and instruments are brought in, including those transferred from new arrivals at St Athan. Inevitably there is a great deal of testing as avionics and other items are reinstalled. After some five months on the ground and about 20,000 man-hours work the 14 Squadron Tornado is ready to be rolled out of the hangar for a test flight and within a few days, return to its busy life at Bruggen.

During its first eight years of front-line service with the RAF, the Tornado GR1 has made a great impact in operational terms. From a very difficult and disappointing early maintenance record it has become more reliable and somewhat easier to keep flying. The combination of severe shortages of spares, technical publications and test equipment, together with little experience to fall back on, were major contributory factors to the problems. These have not yet gone away completely, but the big steps taken by St Athan to fill some of the gaps are beginning to pay dividends, both in terms of reliability and cost-saving.

The Tornado will be continuing in its operational role well into the next century and plans have been announced for a



Back in the Paint Bay, the Tornado is prepared for the final paint stage. RAF St. Athan



'BG' is towed out from the No 10 Squadron's hangar for an early winter morning air test. RAF St. Athan

major modification programme. A contract covering the development phase of a Tornado IDS mid-life up-date for the RAF was signed on 16 March 1989 in Munich by NAMMA and Panavia. The MLU responds to the RAF requirement for enhanced operational efficiency and survivability of the weapon system aimed at ensuring the operational efficiency of the GR1s. This is likely to involve fitting a twin Inertial Navigation Unit (INU) in place of the present single INU; providing a Digital Engine Control Unit (DECU) to replace the GR1's manual ECU, removal of the port side Mauser gun, and replacing the AR123284 by the MSDS Hermes radar homing and warning receiver, all of which are standard on the Tornado F3. The opportunity will also be taken to provide new cockpit displays, a new weapons interface, night flying developments and

avionics up-dates. There will also be new computer software.

The MLU programme, which will cover most of the GR1 fleet between 1992 and 1998, will up-date some of the technology from the 1970s to the 1990s. The opportunity will also be taken to remedy airframe problems, including the emerging wing rivet corrosion and any other structural deficiencies. The MLU will create a significant amount of additional work for Tornado manufacturers, suppliers and RAF St Athan until the end of the next decade. It is 20 years since the RAF's MRCA programme commenced and ten years since the first full production version of the Tornado GR1 flew at Warton. The RAF has made its biggest ever investment in equipment and manpower to keep the Tornado flying as its low-level tactical strike aircraft for the next two decades.

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'Bravo-Alpha' was repainted with a red tail for trials involving all of RAF Germany's squadrons to enhance their visibility while low-flying. Andrew March

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Photographers — win a **Canon E70 8mm VIDEO CAMERA & RECORDER** (worth approximately £800) by entering your photographs (black & white print, colour print or colour transparency) showing any **World War 2 Aircraft in Action**. The photographs may have been taken at any time in the 50 years since September 1939 right up to the present day. The only stipulations are:

- 1 Your photographs must show an aircraft type that was flown during World War 2.
- 2 A maximum of **four** prints or transparencies per entry.
- 3 All entries must be accompanied by the official WW2 Aircraft in Action entry coupon. Photocopies of the coupon will NOT be accepted.

All entries received by the closing date (**30 September 1989**) will be judged by a distinguished panel chaired by Air Chief Marshal Sir Thomas Kennedy, Controller of the RAF Benevolent Fund. A **Canon Video Camera** will be awarded for the best overall print or transparency showing World War 2 Aircraft in Action. Runners-up prizes of a **Canon Sureshot** camera will also be awarded for the best print (colour or black & white) and for the best colour transparency entered. There will be an additional prize for the 'most interesting' photograph entered. Prize winners will be notified individually and a list of names announced in *Air Display International*.

Send your photographs (together with the official entry coupon) to:
WW2 Photographic Competition, P.O. Box 46, Westbury-on-Trym, Bristol BS9 1TF to arrive no later than **30 September 1989**.

Rules

- 1 Photographs submitted for this competition should be clearly marked with the photographer's name and address. They should also state where and when the photograph was taken, if possible.
- 2 If entries are to be returned after the competition they must be accompanied by a suitably sized stamped addressed envelope.
- 3 All photographs submitted as entries in this competition may be published by the RAF Benevolent Fund. Due acknowledgement will be made to the photographer.
- 4 No responsibility can be accepted for loss of entries or damage to them, however caused.
- 5 Decisions of the judges are final — no correspondence will be entered into.
- 6 Prizes are as stated — there can be no cash alternatives.

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Rules

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2. Photocopies of the coupon and handwritten entries will NOT be accepted.
3. No responsibility can be accepted for loss of entries or damage to them, however caused.
4. No correspondence will be entered into.
5. Prizes are as stated — there can be no cash alternatives.

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 B-25 Mitchell
 Blenheim
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 Taylorcraft Auster I
 TBM Avenger
 UC-61 Argus

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R. Simpson, Keeper of Aircraft and Exhibits

Officially opened by HM Queen Elizabeth, the Queen Mother, in November 1978, the Battle of Britain Hall was built to allow a fitting tribute to be paid to one of the most important campaigns ever fought by British armed forces and certainly the most important involving the Royal Air Force's Fighter Command.

Planned as the first major expansion of exhibition space at Hendon it seemed quite natural that it should cover the momentous events now known as the Battle of Britain. Discussions took place to identify the period to be represented in the displays. Perhaps the generally accepted July to October 1940 air battles, or should it extend even wider? After all, two major combatants have differing ideas of the period. The Battle brought home to the people of Britain the full meaning of total war and the hardships and dangers of the front line. It was finally decided to cover not only the more familiar area of Fighter Command, but also other commands and to show what civilians had to endure during the autumn and winter of 1940/41.

The displays cover not only the air

combat but the work of other parts of the RAF which played a vital but less well known part in defeating the German attack. Also illustrated are the crucial roles played by the anti-aircraft guns, searchlights and radar. One could not ignore the work of the Royal Observer Corps or the dangerous work of bomb disposal; all are recorded and have displays showing the work they undertook. Finally, but by no means least, two major displays reflect the ordinary civilian or paramilitary caught up in a conflict over which they had no control. The Blitz street and the Anderson shelter hopefully give some idea of the dangers and hardships as well as the quiet determination to carry on in spite of all these problems.

Although the displays help to relate the story of that historic year of war, beginning in May 1940 when the Germans unleashed their second, and perhaps most successful *Blitzkrieg*, it is the aircraft which are the pride of the collection and form the most visible reminder of this great air battle. Several of the aircraft on display are unique examples of their type but all



are priceless treasures.

As you begin the journey around the aircraft display, it is appropriate that the first aircraft encountered is a Hurricane I wreck. P3175 was allocated to No 257 Squadron and was being flown by Pilot Officer Moffett on 31 August when the unit intercepted an incoming German raid. P3175 came off worst in the combat which followed and crashed, with the pilot being killed. The remains were recovered in the early 1970s and were cleaned but not repaired. They are displayed as an addition to the Roll of Honour to emphasise the human cost paid for the victory.

The first two British fighters to greet the visitor only played a minor part in the Battle. Although Gladiators were operational with No 247 Squadron during the Battle of Britain it was decided to leave K8042 in the pre-war fighter markings of No 87 Squadron, thereby illustrating not only the gaudy colours of pre-war fighter

units, but also more importantly just how quickly the fixed-undercarriage biplane fighter became obsolete in the late thirties. Just two years previously, during the Munich Crisis, more than 85 per cent of Fighter Command's equipment had been biplanes. As Chamberlain searched for peace, Britain's air chiefs knew just how poorly equipped were the forces at their command.

Next to the Gladiator is the only remaining example of the Boulton Paul Defiant. Withdrawn from day fighter use in August 1940 after mounting losses, the type was successfully used later as a night fighter and the Museum has chosen to illustrate this role by retaining the night fighter finish.

The Bristol Blenheim IV, in the codes of No 139 Squadron, is in fact a Bolingbroke acquired from Canada in 1968 in exchange for a Beaufighter from the Museum's Reserve Collection. After many thousands

of hours of work by enthusiasts at A & AEE Boscombe Down the airframe emerged in its splendidly restored form as an example of this classic light bomber. In the summer of 1940 No 139 Squadron's aircraft attacked the German invasion barges in the French Channel ports and by so doing helped to disrupt the invasion timetable.

Pride of place must of course go to the Hurricane and the Spitfire. Without these two superb fighters and the pilots who flew them it is certain the Battle would have been lost. The Museum's examples of this immortal pair are both 1940 veterans. Hurricane I P2617, in No 607 (County of Durham) Squadron and Spitfire I X4590, in No 609 (West Riding of Yorkshire) Squadron markings, are displayed in a reconstruction of a dispersal pen with sandbags and camouflage netting.

Opposite this display of aircraft, forever associated with 'The Few', is a line-up of their erstwhile opponents. Once a most





Far left top: This Hurricane wreck, recovered in the 1970s, is displayed at the entrance to the Hall. Peter R. March

Far left: Gloster Gladiator K8042 in the markings of No 87 Squadron. Peter R. March

Left: Messerschmitt Me110, Junkers Ju88 and Heinkel He111 – three of the Luftwaffe aircraft in the Museum's collection. RAF Museum

Below: Close up view of the Ju88R night-fighter showing the radar aerial array. RAF Museum



unwelcome sight they now represent the largest collection of enemy aircraft in the UK and as such cover some of the most important aircraft types of World War II. The Heinkel He111H-23 is one of the very few German built examples of this late type. This particular machine was built as a military transport in 1944 but is displayed as a representative of the enemy bomber formations which attacked the airfields and later the cities and towns of England.

The Junkers Ju88R-1 on display, although not a bomber of the Battle of Britain period, is perhaps one of the most interesting aircraft exhibits. This night fighter was flown to Dyce by a defecting German crew on 9 May 1943. The aircraft was relatively new, having been introduced into service earlier that year, and was a great prize for the RAE Farnborough who used it extensively on radar investigation and trials work before handing it over to No 1426 (Enemy Aircraft Circus) Flight, for

exhibition flying.

The Messerschmitt Bf110G is another night fighter variant illustrating the RAF's preoccupation with the foes of Bomber Command and their radar equipment capabilities. This aircraft was captured in Belgium and is painted in the distinctive camouflage so typical of German night fighter units during the later years of the war.

The only Italian aircraft in the line-up is a Fiat CR-42 *Falco*. Although unprepared for war Mussolini believed Italy should make a contribution to the Axis victory. The Italian Air Force only managed to organise its forces for participation in the Battle of Britain in the autumn of 1940 after the major operations had already been completed and the Germans repulsed. This CR-42 took part in one of the few Italian raids against the UK and was brought down near Orfordness after an oil line was severed. The aircraft was repaired

and flown by the RAF.

Another Battle of Britain veteran is the Messerschmitt Bf109E-3. Flown by Leutnant Teumer of *Jagdgeschwader 51* on 27 November 1940, the aircraft was shot down by Spitfires. With a damaged radiator Teumer managed to make a successful wheels up landing at Manston. The aircraft was repaired and extensively tested.

The final German aircraft in the display is perhaps the most infamous. The Junkers Ju87 earned its reputation as a vital tool in the *Blitzkrieg* dive bombing tactics employed by the Germans in their early campaigns. However the aircraft's reputation suffered when it was used in air battles where the Germans did not have command of the skies. After suffering at the hands of the British fighter defences it was withdrawn from operations over the British Isles. The Museum's example is a late series anti-tank variant.



Far left: Bristol Blenheim IV light bomber. RAF Museum

Far left middle: Boulton Paul Defiant night-fighter. Peter R. March

Left: Luftwaffe Messerschmitt Bf109 of JG51 captured in 1940. RAF Museum



Westland Lysander R9125. Peter R. March

The white-painted Short Sunderland V on show was built in 1944, after the Battle of the Atlantic had been won, but it rightly takes its place in this Museum. If Coastal Command and the Royal Navy had not kept the sea lanes open to allow the delivery of war material, food and fuel, the course of the Battle of Britain would have been very different and the outcome would almost certainly have been a German victory.

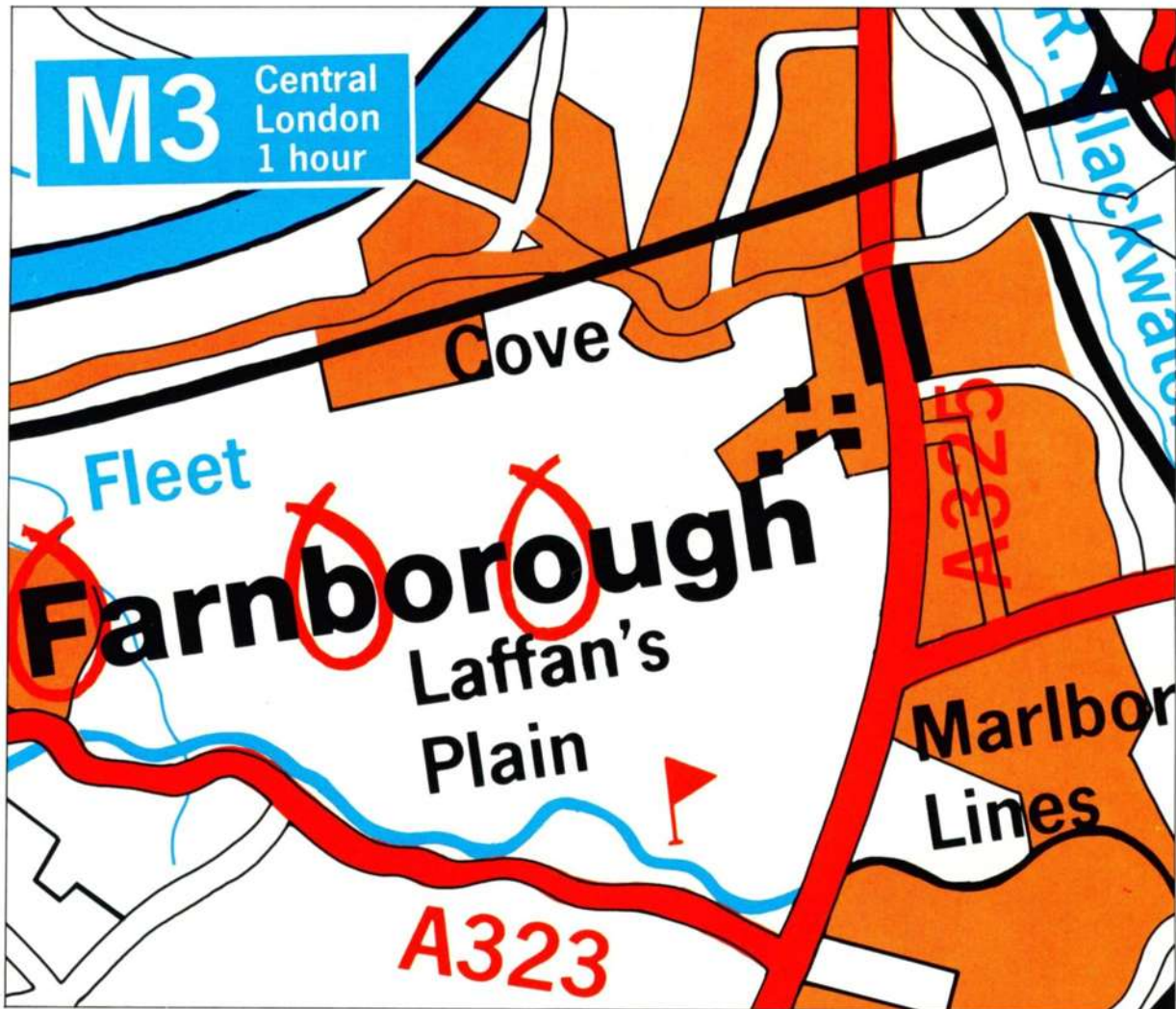
Standing next to the Sunderland and almost dwarfed by its huge neighbour is the Westland Lysander. R9125 was used by No 225 Squadron during and after the Battle for coastal patrol and reconnaissance work. Later the aircraft was allocated to the Special Duties unit, No 161 Squadron. Although this unit was used to land Allied agents in occupied Europe no record has been found of this aircraft's use for such duties.

The last aircraft in our display is the Supermarine Walrus. This machine was imported from Australia in a badly damaged state and stands as a fine example of the craftsmanship of the men working in the Museum's restoration workshops. Operated as the Seagull V by the Royal Australian Air Force the type was ordered into production as the Walrus by the RAF. This versatile machine had many roles but it will be best remembered by the RAF and Allied aircrews for its air sea rescue duties.

During the ten years since this extension opened, its title and status have changed, as the three Museum charities running the Hendon complex have been amalgamated. This has in no way diminished its function as a fitting memorial to the men and women who fought and risked death nearly 50 years ago to win the Battle of Britain.

Supermarine Walrus. Peter R. March





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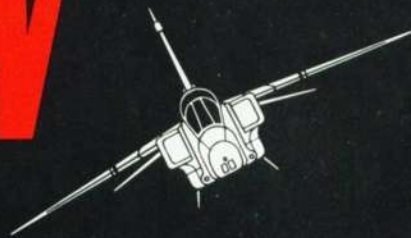
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41(F) SQUADRON



Lindsay Peacock visits No 41(F) Squadron, the RAF's only tactical reconnaissance Jaguar Squadron.

'Seek and Destroy' – No 41(F) Squadron's official motto, as incorporated in the unit crest, is indeed relevant for a unit which enjoys a unique status in today's Royal Air Force. Sharing hangar accommodation at RAF Coltishall, Norfolk with Nos 6 and 54 Squadrons, it is one of a declining number of RAF squadrons which still operate the Jaguar, a type that for a while formed the cornerstone of RAF strike capability, with front-line combat-ready elements at air bases in the United Kingdom and West Germany.

Of the three Coltishall based squadrons, Nos 6 and 54 still function purely in the tactical attack role whereas No 41 is unique, following No 2 Squadron's re-equipment with Panavia Tornado GR1As, in being the sole operator of the Jaguar for tactical reconnaissance. As a consequence, much of the squadron's routine peacetime training activity is directed toward perfecting the techniques used to gather high-quality imagery over the battlefield.

In addition, however, No 41(F) has the

secondary mission of ground attack, a discipline that calls for rather different and, in many ways, conflicting skills if the objective of putting ordnance squarely on target is to be achieved. It should be noted that the word 'secondary' is used advisedly, since pilots are expected to achieve identical levels of proficiency in both tasks. This is only acquired through constant training and the process of bringing a new pilot – for instance, a 'first tourist' fresh from a Tactical Weapons Unit – to combat-ready status is a fairly lengthy one, typically taking around six months.

In terms of assets, it is probably fair to say that No 41 is a large squadron, with a personnel roster of around 230. Since reconnaissance is the primary mission, it follows that the Reconnaissance Intelligence Centre (RIC) accounts for quite a few people, currently a staff of 55. The RIC's responsibilities include processing, interpretation and preparation of intelligence assessments for dissemination to the 'customer' and in periods of peak activity the pressure for

Main picture: No 41 Squadron Jaguar GR1A in winter camouflage.

John Dunnell

No 41 Squadron's unit insignia, which incorporates the cross of St. Omer, is readily apparent on Jaguar GR1A XZ398/D. Lindsay Peacock





results can be very intense. Team members confidently state that the RIC is where the real work is done and there is, perhaps, some truth in that, although they would not hesitate to acknowledge that they are very much dependent on the pilot's skill. If the pilot misses a target, the material he brings back will be worthless and RIC personnel will be unable to provide their assessment. Teamwork is at the heart of a successful operation and when

the team is functioning well, then the results can be truly impressive.

Aircrew and RIC personnel are, in fact, only two elements of the team and they, in turn, are dependent upon others. Engineering, operations and administrative staff constitute the remaining 160 or so members of the squadron and while they may not get much recognition, without them the pilots and the RIC would be unable to function. Without good

engineering back-up to guarantee serviceable aircraft, the squadron's performance would inevitably decline with serious consequences. Similarly, operations staff have an important part to play in ensuring that available assets are put to good use, weighing the merits of the various task requests and endeavouring to satisfy those who require No 41's services in either a reconnaissance or air-to-ground capacity.

Air assets are relatively modest and, No 41's unit establishment comprises about 12 Jaguar GR1As and two Jaguar T2As. All bar one of these are drawn from the two batches of aircraft which incorporate wiring and other modifications associated with carriage of the reconnaissance pod. The solitary exception is a low-time airframe which has spent part of its life on loan to the Indian Air Force and which is configured for reconnaissance missions.

Above left: *Tucking up its undercarriage, a Jaguar GR1A departs from Coltishall. Peter R. March*

Above right: *In this underside view, the centreline reconnaissance pod is 'open', with camera ports unmasked and ready for use. Lindsay Peacock*





Above: Jaguar T2A XX846/Y in company with a GR1A on Coltishall's well-lit flight line. Lindsay Peacock

All of these aircraft have been subjected to the mid-life improvement programme involving the installation of the Ferranti FIN1064 inertial navigation/attack package and associated software in place of the original Marconi NAVWASS. The two-seaters are perhaps less flexible, lacking the ability to operate with the reconnaissance pod and neither possessing in-flight refuelling probes. Nevertheless, they have benefitted from the avionics update programme and could be pressed into service in the attack role.

At the heart of the Jaguar's significant reconnaissance capability is the British Aerospace pod carried on the centre-line stores station. Weighing 1,200lb, it is a hefty item and usually contains five Vinten cameras as well as a British Aerospace Type 401 infra-red line-scan (IRLS) system and air conditioning equipment.

Pod operation is integrated with the FIN1064 nav/attack system, the film being annotated with data which includes grid reference, height, heading and framing rate (varying from four to fifteen frames per second, depending on circumstances). In addition, the pilot may employ an 'event marker' to highlight areas of interest for the interpretation team.

For tactical work, the F95 camera is the prime photographic sensor and each has a magazine containing 250ft of film. The entire package is optimised to produce the best results at 450kt. If these parameters are met, it gives horizon-to-horizon coverage extending about 500 yards to left and right of the Jaguar's track.

At the front of the pod is an F95 Mk 7 camera. This faces forward and is perhaps the least useful although it comes into its own in operations against targets which for some reason cannot be overflown in the normal fashion. The remaining four cameras look to left and right, their focal lengths varying depending on the area covered. Low oblique F95 Mk 10 'inner' cameras have F2.8 lenses, while high oblique 'outer' cameras have F2 optics.

Forward and low oblique cameras are housed in the front drum with the high oblique cameras in the rear drum, both

rotating to expose the cameras for a reconnaissance pass. Ideally, a pass should take the aircraft directly over the top of the target in 'wings level' attitude at the prescribed speed and height, although this is not always possible, terrain being perhaps the biggest obstacle.

At the rear is the IRLS and a magazine with 300ft of film. For use by day or night, this produces a picture built up from radiated heat and normally 'looks' vertically although it may be slewed to provide stand-off coverage. In the vertical mode, it produces a continuous strip of imagery over an area of between 150 to 200 yards to left and right of the Jaguar's flight path.

IRLS has some advantages and some disadvantages. On the plus side, it is useful in the search for underground fortifications and has been employed to detect bodies buried beneath snow. On the negative side, performance is badly impaired by moisture which is one reason why a reconnaissance pass is almost invariably a 'full-sensor' operation, using all five cameras and IRLS.

Although most of No 41's work is predicated upon low-level operation, it is periodically called upon to undertake medium- and high-altitude photography. For such work, the rear drum can take an F126 camera with a F5.6 lens. This offers a broader field of view with typical coverage at 5,000ft being of the order of 2,500yds. Imagery obtained from this device is most often used in planning, with examples of application including the survey of beaches prior to an amphibious landing and assessing lines-of-sight for observation or sniper posts.

As well as changing the camera fit, it is possible to change the type of film. Perhaps the best example is the occasional use of infra-red false colour. The resulting pictures may look peculiar but are startlingly effective in observing camouflage, for the film clearly reveals the amount of chlorophyll present, dying or dead foliage providing a stark contrast to healthy trees.

Turning to ground attack, the avionics

update has significantly enhanced capability to the point where Jaguar pilots can reasonably expect to achieve a successful 'first-pass' attack although the lack of terrain-following radar means that they are restricted to day operations under visual flight rules (VFR) conditions. Weapons options vary considerably, Hunting's BL755 Cluster Bomb Unit (CBU) being one item that would probably figure fairly highly as does the 1,000lb bomb, in either slick or retarded form.

Peacetime training in delivery techniques recognises the different attack profiles which could be employed. Low-level lay-down and 'toss' bombing are frequently practiced. Opportunities to expend full-size weapons do not arise very often but are valuable in that they provide 'feel' for handling the aircraft when it is carrying the real thing — however, the most commonly used items of ordnance are lightweight practice bombs.

Gunnery against ground targets is also practised fairly regularly, the Jaguar possessing a powerful punch with two 30mm Aden cannon. Air-to-air combat is not forgotten either. Annual air combat training (ACT) and dissimilar air combat training (DACT) sessions allow pilots to hone their skills. In DACT, aircraft are generally flown 'clean' apart from practice AIM-9 Sidewinders with active seeker heads. In the real war situation, however, pilots would probably choose to evade combat since even its most ardent supporters acknowledge that the Jaguar has deficiencies in terms of power and agility.

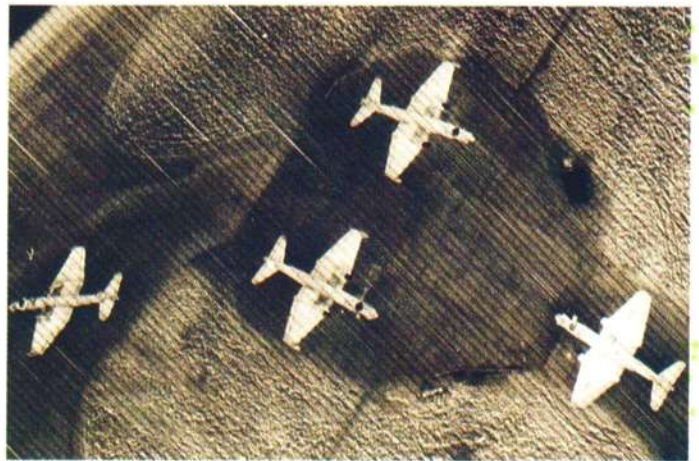
No 41(F) Squadron's peacetime base is Coltishall, Norfolk but as it forms part of No 1 Groups's Offensive Air Support Division it would, in the event of a European war, quickly move to the Continent, either as a regional reinforcement squadron declared to Supreme Allied Commander Europe (SACEUR), or as part of the Allied Command Europe Mobile Force (AMF). It could be sent almost anywhere in Europe but the most likely destination would be Bardufoss, where it would beef up



The camera pod is clearly visible as the Jaguar banks away. Three camera ports may be seen, as can the IRLS sensor, towards the rear of the pod. The silvery object directly ahead of the port ventral fin is an AN/ALE-40 chaff/flare dispenser. Lindsay Peacock



With the aid of a light table, Reconnaissance Intelligence Centre personnel analyse the imagery that results from a single Jaguar sortie. Lindsay Peacock.



Some idea of the capability of the Infra-Red Line-Scan sensor can be gained from this view of Canberra T17s at Wyton, taken by a Jaguar flying at 300ft. No 41 Sqn, RAF

Norway's modest air arm.

Regardless of where it goes, it follows that mobility is a watchword, thus No 41 faces a hectic schedule of deployments and detachments. At least three or four visits are made annually to Norway but it frequently appears at other bases, such as Volkel, Bremgarten and Laarbruch. Movement to Norway is generally accomplished with in-flight refuelling while vital support personnel and associated fly-away packs travel more sedately aboard Hercules transports.

RIC equipment includes a number of Air Transportable Reconnaissance Exploitation Laboratories (ATRELS) which contain all the equipment necessary to perform processing and interpretation in the field. A set of 10 or 11 ATREL cabins is needed to support the full squadron. Movement of ATREL cabins can be achieved by air or road and both methods are frequently practised so as to ensure that the squadron can meet the period of notice required by NATO.

In the event of war, once No 41 (F) Squadron reaches its deployment base — whether it be in Norway or elsewhere — it will at first direct all of its energies towards reconnaissance to provide the intelligence

that is necessary for the effective conduct of battle. With the initial phase over, emphasis will then shift away from pure reconnaissance to include ground attack, with squadron resources being roughly evenly divided between these two missions.

Once the need for a reconnaissance sortie has been identified, whether it originates from Army forces on the ground or from Allied air power intent on executing a strike attack mission No 41 will normally be directed to fly the sortie by a Tactical Air Operations Centre (TAOC), the message specifying the area to be reconnoitred and allocating a time-on-target amongst other things. Targets fall into one of 17 different categories, grouped together by classification. The principal categories are airfields, bridges and electronic facilities.

Most operations will be flown in direct support of the Army and it is usual for the squadron to work to Corps or Brigade level. Naturally, responsiveness to the needs of field forces is a paramount concern. In peacetime training No 41 has often demonstrated the ability to come up with 'the goods' within three hours of being tasked, that time including briefing, planning, flying the reconnaissance

mission and analysing the data that is obtained. Similar, if not better, levels of performance will be expected in the event of war.

On receipt at the squadron's operations facility, the task message goes first to the Ground Liaison Officer (GLO), an Army officer attached to the squadron to serve as a link between air and ground echelons. It is the GLO's job to brief the pilot on the requirements of the mission he is about to undertake. Once that is complete, the pilot plans the route he will fly, bearing in mind that he will probably have to pass through safe corridors over the FLOT/FSCL (Forward Line Own Troops/Fire Support Coordination Line) while avoiding known enemy defence and friendly combat air patrols.

The reconnaissance pilot will have to determine the best approach path to the target. The latter is by no means easy since it has to take into account prevailing lighting conditions, local enemy defences and include a suitably distinctive initial point (IP) to mark the start of the run-in to the target. Large scale maps are used for target approach and departure routings with smaller scale maps for the final stages of the run in.



In the year that it joins the front line, *Paul Jackson* compares the new Harrier GR5 with its predecessor, the GR3 and concludes that it is . . .

THE SAME BUT DIFFERENT

The shape may be familiar — apart from a higher-set cockpit and a bigger wing — but it would be wrong to regard the new variant of Harrier now flying from RAF Wittering as merely the recipient of cosmetic refinements. Exactly 20 years after this Cambridgeshire airbase received the world's first operational vertical take-off combat aircraft, aircrew of the resident No 1 Squadron and No 233 Operational Conversion Unit are discovering what a difference can be made by two decades of progress in aerodynamics, engineering and electronics.

Whichever way you look at it, the aircraft called the 'Harrier II' by its manufacturers, is a generation ahead of the 'Jump Jets' introduced to RAF service in the early 1970s for close-support/ground attack duties. The new Harrier (known to the RAF as the 'GR5') can lift nearly twice its predecessor's warload or carry the same weaponry twice as far — and, incredibly, does so with the same engine delivering much the same thrust! In addition, the GR5 can attack with increased accuracy and is considerably more adept at evading the unwelcome attentions of the enemy. Add



Above: The higher-perched cockpit is one of the key recognition features of the Harrier GR5 – it also has four extra weapons pylons, leading edge root extensions and re-positioned outrigger wheels. BAe

Top: Four Harrier GR5s of No 233 OCU return to Wittering from the Holbeach ranges after a weapons training sortie. Paul Jackson

to this the opinion of one experienced Harrier pilot that the GR5 is, 'in terms of avionics, virtually an F-18 Hornet, lacking only the radar' and it will be seen that the RAF has received the equivalent of a new aircraft whilst being able to keep most of the personnel skills and infrastructure handed-down from the old.

The GR5 is the result of McDonnell Douglas being given the rights to develop a second-generation Harrier for the US Marine Corps. A complete revision of the design has been undertaken by the US firm, modernising where necessary but keeping what does not require changing. Much of the credit for the GR5's greatly enhanced performance can be given to the wing, which is entirely new. Not only has it 14.5% more area, 20% greater span and generously-sized flaps to give increased lift, but it is also built of carbon fibre for lightness and strength. The GR5 is the first RAF aircraft to employ this material to any

significant degree, the wing being 331lb (150kg) lighter than if it were made of metal.

As well as supporting four more weapons pylons and containing 2,000lb (907kg) more fuel than its predecessor, the new wing has the out-rigger undercarriage legs at about half-span, instead of at the wingtips, to simplify operations from roadway airstrips. Reaction control valves – which are responsible for maintaining stability at the hover by directing air bled from the engine – remain at their original positions in the wingtips, nose and tail extension.

The GR5's big wing is combined with leading-edge root extensions (LERX) to give exceptional manoeuvrability. Though marginally slower, flat out, than the GR3, the GR5 can augment the Harrier family's well-known VIFF (vectoring in forward flight) capability with better turn rates. Marine Corps Harriers have demonstrated

an average 2:1 superiority over the whole range of US Navy aircraft during close-in fighting, and this experience is being repeated by the RAF. Even a GR3, if it does not score with a head-on shot at the first pass, has no chance thereafter in a turning fight with its successor.

The fuselage is mostly of metal to withstand the heat from the four swivelling jet nozzles which give the Harrier its remarkable STO/VL performance. STO/VL (short take-off and vertical landing) is the normal mode of operation because the aircraft can carry greater warloads if it takes a few hundred feet to lift off. The cockpit section is entirely revised and made of carbon fibre. Immediately noticeable is the raised seat – 12in (30cm) higher than the GR3, like the Sea Harrier – which modifies the nose profile and greatly improves the pilot's view for landing and during the attack phase of the mission.

Incorporation of many ingenious weight economies and lift-improvement devices (LIDs) has resulted in the GR5 taking-off 40–50kt (74–93km/h) slower, and also requiring less engine power (therefore generating less noise) during a vertical landing. Tighter circuits of the operating base can be flown with the big wing Harrier so, environmentally, the GR5 is altogether a better neighbour than the Mk 3.

The HUD (head-up display), fitted to the GR3, to present basic flying and weapon-aiming data in the pilot's line-of-sight, was a first step towards providing a 'user friendly' combat aircraft cockpit. One generation on, the GR5 has an ergonomically designed environment based on the HOTAS (hands on throttle and stick) concept. Whereas the GR3 had the RAF's most cramped cockpit, that of the GR5 is more spacious and logically arranged. The HUD – though now a far 'cleverer' model – is still there, and immediately below it is the 'up-front control set' containing push-buttons for all essential communications, navigation, identification and weapons selectors. The two basic hand controls of throttle and column ('stick') are festooned with a total of 14 auxiliary switches associated with the selections it might be necessary to make whilst in the heat of battle. In the GR3, it was necessary to *change hands* to make some selections during the run-in to an attack, but this is now a thing of the past.

On the right of the instrument panel is a moving map display presenting the pilot with his ground position to an accuracy of less than 1 mile (1.6km) during an hour's sortie. The left side contains a multi-function TV screen which, at the appropriate times, presents data on the status of weapons and stores management, course to be steered, radar warning receiver (RWR), engine parameters and built-in systems test data. When approaching a target, the screen shows a picture obtained by the Hughes ARBS (Angle Rate Bombing Set) mounted in the extreme nose.

ARBS has two basic modes. As a laser spot tracker it allows the pilot to acquire visually a target which is being 'illuminated' by a laser source in another type of aircraft

or directed by an allied soldier. A TV camera with magnifying lens included in the system allows the ARBS to keep track of a target once it has been sighted through the HUD. The pilot then simply follows manoeuvring instructions generated by the computer and displayed in his HUD to ensure an accurate attack.

Naturally, the enemy will not stand idly by whilst this is going on. Protection against air- and surface-based anti-aircraft systems is provided by the Marconi Zeus countermeasures suite, which includes C/J-Band RWR antennae at the wingtips, nose and tail, plus transmitter aerials for the jamming component. Zeus has a computerised library of up to 1,000 types of hostile emitter and will automatically initiate the appropriate action against each. Augmenting this will be a Plessey-designed Missile Approach Warning (MAW) system, comprising a lightweight radar in the tailboom which looks for missiles. According to the type of threat which Zeus and MAW detect, they will warn the pilot and may activate a chaff/flare dispenser located in the undercarriage outrigger fairings, to confuse radar-homing and heat-seeking missiles, respectively. It will be noted that the above-mentioned equipment is internal, so valuable weapon pylons do not have to be taken-up with self-protection pods.

Engineers familiar with the GR3 have welcomed the GR5's arrival. Although it relies to a greater extent on electronics, the new Harrier has been designed with maintainability in mind. Regularly-serviced components are easily accessible behind quick-release panels, and those problems which have been experienced are confidently dismissed as 'teething troubles'. McDonnell Douglas intended the Harrier II to need 60% less maintenance hours and 60% less ground support equipment, so ex-GR3 units are finding an increased number of their aircraft out on the flight line each morning.

Unlike other RAF combat aircraft, the GR5 will not be sent to the Engineering Wing at St Athan for a 'Major' overhaul after every 1,000 or so flying hours. 'Primary' and 'Minor' servicing will be performed at shorter intervals on the aircraft's home station, and it is envisaged that no more extensive form of examination will be necessary. Even the Pegasus engine, though essentially the same as in the GR3, has been made less demanding of maintenance time by the addition of a computerised Digital Engine Control System. DECS ensures optimum engine performance under all conditions and even includes a rapid thrust-dumping mode to save pilots' red faces by preventing 'bounce' on vertical landing.

In 1981, the Ministry of Defence decided to order the AV-8B Harrier II for the RAF and British Aerospace commenced the construction of two development and 60 production aircraft, designated GR5. This was increased to a total of 96 in April 1988 when a further 34 were ordered. The first Harrier GR5 ZD318, made its maiden flight at BAe's Dunsfold aerodrome on 30 April 1985. So that Wittering's engineers could become familiar with the new model, the sixth machine was flown in on 29 May



Top: A Harrier GR5 loaded with seven dummy BL755 cluster bombs, for attacking concentrations of armoured vehicles, plus two AIM-9 Sidewinder missiles for self-defence. BAe

Middle: The first GR5 delivered to the RAF at Wittering was ZD323 on 29 May 1987. After static instructional use by the maintenance school, it joined No 233 OCU Paul Jackson

Above: The two-seat Harrier T4 will continue to be used as a conversion trainer for the GR5 for the foreseeable future. John Dunnell

1987, a little ahead of the 'official first delivery', when ZD324 was handed-over to the RAF on 1 July that year.

However, as a result of technical difficulties with the inertial navigation system the introduction date was put back to 1 November 1987. Unfortunately misfortune struck when a BAe test pilot and his aircraft were lost in mysterious circumstances on 22 October. Development flying was suspended while the accident was investigated and appropriate modifications incorporated, resulting in a total of nine months' delay to the start of pilot training.

Harrier type conversion is conducted by No 233 OCU, currently commanded by Wing Commander Peter Day, its fleet originally being nine tandem-seat Harrier T4s and a similar number of single-place GR3 aircraft. In normal times the OCU comprises two flying elements: 'A'

Squadron, responsible for weapons training (gunnery, bombing, tactical navigation and leadership), post-graduate training of weapons instructors and fighter-reconnaissance instructors, and refresher courses; and 'B' Squadron, handling Harrier type conversion, air combat training, post graduate training of flying instructors and instrument-rating examiners, and conversion of Royal Navy pilots (for the Sea Harrier).

To bring the GR5 into service, a three-man Harrier Conversion Team (HCT) formed within No 233 OCU under the command of Squadron Leader Jonathan Baynton and began its own training in February 1987 by taking a ground school

Centrespread: Harriers ancient and modern. Wearing the markings of Wittering-based No 233 OCU, a Harrier GR5 formates on its older brother, the GR3. BAe







This view shows the large carbon-fibre wing and armament pylons. Paul Jackson

and simulator course with the US Marines at Cherry Point, North Carolina.

As the programme had been substantially delayed personnel had to return to the US for conversion flying, so it was not until the afternoon of 30 March 1988 that the HCT flew its first sortie, when Sqdn Ldr Baynton took ZD324 aloft.

HCT1 — the first training course — began on 18 July 1988, and by the end of the year 15 personnel had been converted in three courses. Instruction takes seven weeks, of which the last is spent in Spain, where the Spanish Navy's Harrier II simulator is used pending eventual arrival of the RAF's own Singer-Link-Miles unit at Wittering. Prior training in UK skies is prefixed by eight days in the ground school and involves 16 sorties totalling 15 hours. Five of these flights are to a weapons range, where the eight or more bombing modes possible with the ARBS are evaluated.

By April 1989, some OCU pilots and all of co-resident No 1 Squadron had been through the HCT. The HCT will begin converting Germany-based No 3 Squadron in mid-1989, closing its doors for the last time at the end of this year, after the 11th course. The OCU will then have assumed responsibility for training new pilots from both the flying schools and other types of front-line aircraft, beginning with its first GR5 course in August 1989.

As was the case with the GR3, the appropriately-titled No 1 Squadron is the first to take the new Harrier into front-line service. Its initial GR5 was delivered on 23 November 1988, and since February it has

been up to strength with 12 aircraft. It will become fully operational this autumn. The squadron, under the command of Wing Commander Iain Harvey, will then be prepared to move anywhere in Europe at short notice, taking its supporting personnel and their tents and equipment by Hercules transport. For maximum readiness, its GR5s will permanently wear a 'bolt-on' airborne refuelling probe which lies flush with the port air intake until required.

Plans having been abandoned — at least for the moment — to fit the GR5 with a nose-mounted infra-red reconnaissance sensor, No 1 has lost its tactical recce capability. In other respects, the GR5 will operate from small, concealed sites in the manner of its inimitable predecessor, providing close-support for Allied troops, with similar armament.

Weaponry comprises the 582lb (264kg) Hunting Improved BL755 cluster bomb (against armoured vehicles); 540lb and 1,000lb (245 and 454kg) high explosive bomb — free-fall or with a tail-mounted retarding parachute; laser-guided 1,210lb (549kg) Paveway bomb; and MATRA 155 pods containing 18 rockets of 68mm calibre. Up to seven of these weapons can be hung on pylons — three beneath each wing and one on the fuselage centreline. Additionally, rails mounted on the front of the outrigger fairings house an AIM-9L Sidewinder air-to-air missile for self-defence, and a pair of pods under the fuselage each contain an ADEN cannon with its 100 rounds of 25mm ammunition. The aircraft's theoretical maximum weapon load is 9,200lb (4,173kg), although a more normal figure would be somewhat less than this to allow for fuel reserves. A short, rolling take-off allows the GR5 capacity for 16,000lb (7,257kg) of fuel and weapons, the exact mix being dictated by the distance to the target.

New armament and new methods of delivering it are in the pipeline for the early 1990s, once Nos 3 and 4 Squadrons at Gütersloh, West Germany, have been converted from GR3s to end the GR5 re-equipment programme. Harriers will receive the new stand-off anti-armour weapon currently being developed to meet

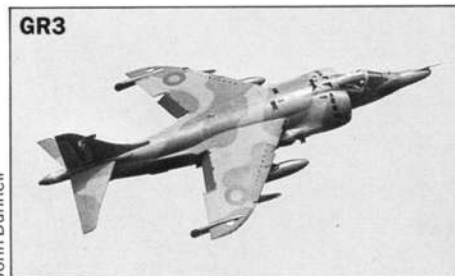
the ASR 1238 specification for a BL755 replacement and will gain night vision systems to enable them to be as effective in clear, dark weather as they are by day.

Development of tactics is being entrusted to the Strike/Attack Operational Evaluation Unit at Boscombe Down. The SAEU received the first of its three GR5s on 26 July 1988, and will use them to establish the most effective way of employing the aircraft in combat and upgrading its potential.

As part of this programme, RAF Harrier GR5s are to be equipped with a GEC Avionics FLIR (forward-looking infra-red) system on top of the nose; a new Smith's Industries Head Up Display unit which will display the TV-like FLIR image in the pilot's line of sight, so turning night into day; a computerised moving-map navigation display; and cockpit lighting compatible with pilot's night vision goggles. From the 63rd RAF Harrier II onwards, aircraft will be delivered with this greatly enhanced operational kit, their designation becoming GR7. In advance of that, a partial night system will be fitted in Nos 42–62. After Nos 1–41 have been upgraded to GR7 standard, the interim models will have the balance of their night avionics installed. Harrier T4s will continue to provide lead-in training for the GR5/GR7 until well into the next decade, if not for longer, some of them with added night vision equipment under the new designation, T6.

On few occasions in the history of the RAF has the simple change of a mark number covered such a dramatic change in an aircraft's potential. Compared with its predecessor, the GR5 can carry 50% more internal fuel; 400% more external fuel; or deliver 70% more ordnance with 200% greater accuracy. The GR7 will double the GR5's potential by doing all this during clear nights when other Harriers would be grounded. Future developments will give the GR7 all-weather capability, thereby increasing the times it can operate by a further two-thirds. Add to this the promise offered by the 25,000lb (11,340kg) thrust Pegasus 11–61 developed for the US Marine Corps, and it will be realised that GR5 is not the end of the Harrier story, but merely the end of the beginning.

GR3



John Dunnell

GR5



Paul Jackson

HARRIER COMPARISONS

	HARRIER GR3	HARRIER GR5
Span	25ft 3in	30ft 4in
Length overall	46ft 10in	46ft 4in
Height	11ft 11in	11ft 8in
Wing area	201sq ft	230sq ft
Outrigger wheel track	22ft 0in	17ft 0in
Max take-off weight	25,200lb	31,000lb
Operational weight empty	13,300lb approx	15,000lb approx
Typical warload	2,730lb	5,770lb
Internal fuel	633 Imp gal	915 Imp gal
Max external fuel	663 Imp gal	1,000 Imp gal
Power plant	Pegasus 103	Pegasus 105
Thrust	21,500lb	21,700lb
'g' limitations	+7.8/-4.2	+7.0/-2.8
Max sea level speed	731mph	679mph

It is becoming hard to recall a time when the *Red Arrows* was not the RAF's premiere display team. In fact you have to go back to 1964 and to the *Red Pelicans* of the Central Flying School to find the *Arrows'* predecessor. The last RAF aerobatic team to fly front-line fighter aircraft was No 56 Squadron's *Firebirds* team with nine red and silver painted Lightnings in 1963.

Without doubt the most famous operational aircraft to be flown by the RAF's premier team was the Hawker Hunter. In 1957 Squadron Leader R. L. Topp led five black-painted Hunters from No 111 Squadron, which became known as the *Black Arrows*. At Farnborough the following year Treble One Squadron provided the spectacle of a 22-Hunter loop, the greatest number of aircraft ever looped in formation. Subsequently led by Squadron Leader P. A. Latham, the *Black Arrows* continued as the RAF's aerobatic team until 1961, when it was replaced by the *Blue Diamonds* of No 92 Squadron.

Lightnings of No 74 Squadron (*The Tigers*) were given the leading role in 1962 and No 56 Squadron (*The Firebirds*) took on the mantle in 1963. It was decided in that year, for operational and economic reasons, that the RAF's leading team should be drawn from a training unit, rather than from front-line fighter squadrons. So in 1964 the *Red Pelicans*, flying six Jet Provost T4s, became the first Central Flying School team to be given the leading rôle for over 30 years. Despite an extremely polished aerobatic display, the relatively slow and ungainly Jet Provost compared unfavourably with the sleek Hunter and powerful Lightning, thus reducing the impact of the team's performance.

As a consequence a second aerobatic team was formed, with five yellow-painted Gnats flown by instructors from No 4 FTS at Valley under the leadership of Flight Lieutenant Lee Jones. Known as the *Yellowjacks*, the team represented the RAF at Farnborough in 1964 alongside the *Red Pelicans*. The Gnat was an ideal compromise between the front-line jet fighters and the less attractive jet trainers. The classic swept wing lines of the aircraft lent itself to symmetrical formation



The RAF aerobatic team flying five HS Gnats gave its first public display on 25 July 1964. Twenty-five years later we mark the

SILVER JUBILEE OF THE **RED ARROWS**

Andrew March

From Yellowjacks to Red Arrows — photographs spanning 25 years of the RAF's aerobatic team.
Top: Yellowjacks Gnats 1964. Rolls-Royce
Middle: Red Arrows Gnats 1977. Peter R. March
Below: Red Arrows Hawks 1988. R. Hollis





Left top: *Lightnings of The Tigers display team at Farnborough.* Photographs Peter R. March unless otherwise credited.
 Left: *Yellowjacks Gnats prepare for their display.*
 Above: *The Red Arrows line-up in 1966.* Crown Copyright

shapes and its hitherto unsurpassed manoeuvrability, with accuracy of control, assured slick, accurate formation changes.

While Flt Lt Jones was well qualified to lead the Gnat team, having previously been a member of the *Black Arrows* and leader of a Hunter team at No 229 OCU, Chivenor, there was some uncertainty about the aircraft. The Gnat had entered service in 1962 and still had a number of introductory technical problems and the A&AEE at Boscombe Down had warned, in a handling assessment, that it might not prove very practicable for formation aerobatics. The *Yellowjacks* were allocated ten aircraft for their five-ship display routine and as it turned out this was an unnecessarily generous provision. The team made its first public appearance at the Cudrose Air Day on 25 July 1964 and was an instant success. So much so that it was decided, shortly after appearing with the *Red Pelicans* at Farnborough, to form a Gnat team for 1965 under the leadership of Flt Lt Lee Jones, to replace the Jet Provosts as the RAF's premier aerobatic team.

Like the *Red Pelicans* before it, the newcomer was established on an annual basis as part of the Central Flying School, which at that time was based at RAF Little Rissington, Glos. It was officially dubbed the *Red Arrows*, adopting the colour associated with the CFS and the arrow-like shape of the Gnat and its formations from the earlier 111 Squadron Hunter team. The ten red-painted aircraft were initially based at RAF Fairford as a CFS detachment. The pilot establishment was increased to eight,



Above: *A special presentation was made to the Red Arrows on the occasion of their 1000th display in 1977.*

Below: *Red Arrows 'Diamond Nine'.*



to fly a seven-ship formation, with a permanent reserve. Amongst the newcomers to the team were Flight Lieutenants Ray Hanna and Bill Loverseed, both of whom became leaders of the *Red Arrows* in later years.

Hard winter practice enabled the team to

be ready for the opening of the 1965 display season. Their public debut at the Biggin Hill Air Fair in May 1965 was followed by some 50 appearances, including visits to Belgium, France, Italy, Netherlands and West Germany. The *Arrows* were awarded the Britannia Trophy by the Royal Aero Club in recognition of the outstanding contribution to British prestige in the field of aviation.

1966 saw the seven aircraft team under the leadership of newly promoted Squadron Leader Ray Hanna and just under 90 shows were flown by the end of the season. Technical problems with the Gnat, which meant a detailed structural check of each aircraft, delayed the start of the 1967 season. But nevertheless nearly 100 public appearances were made.

In 1968 a team of nine pilots, without any reserves, was approved. Since then the *Red Arrows* 'Diamond Nine' formation has come to represent the peak of precision formation flying. Such was the team's outstanding success that in 1969, Ray Hanna's final year as leader, it was decided to establish the *Red Arrows* on a permanent basis with the CFS, with an equivalent status to a full RAF Squadron. A move had earlier been made to RAF Kemble which was to remain the home base for more than 16 years.

Through the 1970s the team had a succession of six leaders (Squadron Leaders Hazell, Loverseed, Dick, Duckett, Hoare and Hoskins), with eight further pilots and a manager, the latter flying the 'spare' aircraft to displays and 'performing' as commentator. In 1973 the *Arrows* gave

Synchro Pair cross – Gnat.



Hawk Synchro Pair.



103 public displays during the season, topping the 100 mark for the first time. The fuel crisis of 1974 prevented the team from giving public displays until July that year. In the first ten years as the RAF's aerobatic team some 850 displays were given and the 1,000th performance came in 1977 at the International Air Tattoo at Greenham Common. By the end of the 1979 season when the Gnats were scheduled to be replaced by the new BAE Hawk T1, the team had given 1,292 public performances, involving visits to 18 overseas countries.

The *Red Arrows* took delivery of the Hawk in the winter of 1979/80, setting Squadron Leader Brian Hoskins the task of seeing through the conversion of the pilots from Gnat to Hawk, introducing two new team members and working up a display using a new aeroplane, in time for the start of the 1980 season. The fact that the team was ready to display on time was not only a tribute to the pilots and ground crew, but also evidence that the Hawk was a worthy successor to the Gnat.

Through this decade the *Red Arrows*, under the leadership of Squadron Leaders John Blackwell (1982-84) and Richard Thomas (1985-87), have flown the Hawk, not only in Britain and Europe but also on major tours to North America, the Middle East and Scandinavia. The most ambitious tour, to the Far East, was completed in 1986. It involved giving 22 displays in 15 countries, and travelling 18,500 miles in six weeks.

Now under the leadership of Squadron Leader Tim Miller, the *Red Arrows* had, by the end of the 1988 season, completed 2,313 public displays. With the addition of Spain and Luxembourg last year, the total number of countries visited became 38.

There can be little doubt that throughout the years that the *Red Arrows* has been the UK's premiere aerobatic team it has made a tremendous contribution to the prestige of the RAF, as a public demonstration of the air arm's ability to operate regularly and reliably to an exacting standard and underlining the skill of its pilots and professional capability of the engineers and support staff. The *Red Arrows'* programme for 1989 is just as exacting, with over 100 appearances planned, including visits to eight European countries. The following dates and locations have been provisionally programmed. They are, of course subject to change. It should be noted that some of the displays will be given at private events and the public may not be admitted.

The *Red Arrows* 1989 season ends on 4 October with a 25th birthday celebration at RAF Scampton. This **ticket only** event will include a flying display, which it is hoped will include other major aerobatic teams and RAF airshow participants.

Limited pre-purchased tickets at £25 per car (including up to six occupants) can only be obtained from:

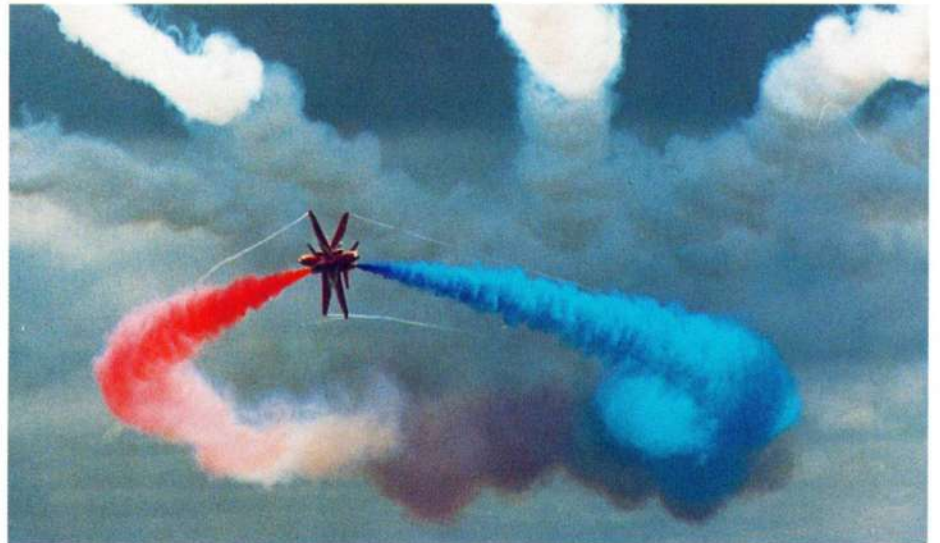
Eric Ward Associates Ltd
12 Digby Drive, Leicester Road
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Cheques should be made payable to The Red Arrows Trustees Ltd. All applications should enclose a stamped, addressed envelope.



Above: Delta Roll — the 1989 Red Arrows.

Below: Synchro Pair crossover. Stephen Bennett



RED ARROWS DISPLAY PROGRAMME 1989

MAY	2	Alnwick	19	Bowness	
13	RAF Wyton	3	Stranraer	19	RAF Valley
14	Staverton	7	Plymouth	20	Blackpool
19	RAF Odiham	8	RAF Wyton	20	Swansea
20	Austria — Graz	9	Belgium — Koksijde	23	Stafford
21	RAF Waddington	15	RAF Benson	24	Dartmouth
27-28	RAF Mildenhall	15	RAF Cottesmore	25	Staverton
28-29	Southend Sea-front	16	RAF Church Fenton	26-27	Exeter
29	Seaham	16	RAF Bentwaters	27	Cowes
		17	Teignmouth	28	West Malling
JUNE	3	Netherlands — Scheveningen	22	RNAS Lee-on-Solent	
4	Norway — Kristiansand	22-23	RAF Fairford	SEPTEMBER	
6	Ramsey & Douglas, IoM	23	Humberside	2	Wirral
8	Peel & Douglas, IoM	26	RNAS Culdrose	3	Eastbourne
10	RAF Stafford	26	RAF Chivenor	8	RAF Lyneham
10	Prestwick	27	Weston-super-Mare	9	Eastney
11	RAF Cosford	27	RAF Brawdy	10	Belgium — St Truiden
11	RAF Swanton Morley	28	Lyme Regis	14	Guernsey
11	Duxford	29	Plymouth	14	Jersey
15	Belgium — SHAPE HQ	29	RNAS Yeovilton	16	RAF Abingdon
17	RAF Coningsby	30	Swanage	16	RAF St Athan
17	RAF Halton	30	Duxford	17	Duxford
18	Biggin Hill			20-21	RAF Leconfield
24	Woodford	AUGUST		23	RAF Finningley
24	RAF Wattisham	9	Falmouth	23	RAF Leuchars
25	Switzerland — Sion	9	RAF St Mawgan	24	Cranfield
29	RAF Marham	12	Cumbernauld	26	Monte Carlo
		13	Morecombe	30	RAF Gibraltar
JULY		13	Whitby	OCTOBER	
1	RAF Staxton Wold	16	Cromer	4	RAF Scampton
1	Brough	16	Weymouth		
2	Dundee	17	Fowey		

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To mark the introduction of the Tornado F3 air defence fighter into the RAF, the Service and British Aerospace commissioned a painting by the renowned aviation artist Frank Wootton. The original, which depicts 2 Tornado ADVs taking off from RAF Coningsby in Lincolnshire, is now fittingly displayed at RAF Bentley Priory which was the home of Fighter Command during the Second World War and is now headquarters No 11 Group RAF. A special limited edition of 500 fine-art prints have been produced for sale with all proceeds in aid of the **Lord Dowding Sheltered Housing Appeal**, a project sponsored jointly by the RAF Benevolent Fund and the Royal Air Force Association.



Each litho-coloured print is serially numbered and personally signed by the artist and Wing Commander R S Peacock-Edwards AFC RAF who was the Officer Commanding No 229 OCU when the aircraft first entered service. Measuring 14.4" x 21" (with border 21.5" x 27"), the prints are unframed so that you can choose the style and colour to suit your decor. For a print of this high quality it is a real bargain at only £45 when similar works by Frank Wootton normally sell for considerably more.

Frank Wootton's illustrations on canvas of the story of RAF aircraft from the foundation of the Service to the present day are without parallel. Eminent among aeronautical artists, he is a Sussex man born and bred, who volunteered for the RAF in 1939 and has flown in most of the aircraft that he has so vividly painted. He has a unique ability to capture the limitless variety of light and shade, colour and tone, and such has been the accuracy of his observation his paintings are far more than just photographic style representations, they are also true works of art that really give the impression of flight and movement. These qualities are brilliantly realised in the Tornado prints. If you wish to take advantage of this exclusive offer and help a deserving cause, then please forward a cheque for the right amount payable to 'NONPAS RAF Stanmore Park' to the following address:

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RAF/89

RAF LEEMING

BRIDGING THE HUMBER-FORTH GAP

In 1938 Clapham Lodge Farm and Wilson's Farm, in North Yorkshire, were made into an airfield for use by Yorkshire Air Services, which was one of the first flying clubs in England. Later that year this ground and the adjacent land of Newton House Farm, which was used by local gentry as a cricket ground and was hence 'hallowed' turf, was acquired by the Crown. It was drained, levelled and made into the airfield which is now Royal Air Force Leeming. Some fifty years later the airfield underwent one of the RAF's biggest and most intensive building programmes to date, to enable it to accommodate three Panavia Tornado F3 air defence fighter squadrons.

The decision to develop a new air defence base in North Yorkshire, and the choice of RAF Leeming in particular, can be traced back to the Conservative Manifesto of 1979. This committed the government to improve the air defence of the UK, following the general decrease in fighter strength during the previous 20 years, in line with NATO's trip-wire policy.

The decrease had resulted in the closure of all the air defence fighter bases in Yorkshire including RAF Leeming, which was then a night fighter station. It was withdrawn from this role and transferred to Flying Training Command. For twenty years,

during the 1960s and 70s, RAF Leeming was a flying training base, ultimately hosting the Central Flying School.

A reverse to this policy began in the 1970s, when a significant conventional threat to the UK was recognised. By 1974, for example, the NATO Alliance was faced with the Warsaw Pact's superiority both in manpower and conventional weaponry. In spite of air-to-air refuelling increasing the range of fighters, the locations of the main air defence fighter bases were either in Scotland, Lincolnshire or Suffolk and left a potential hole in the UK's air defences, which became known as the Humber-Forth Gap.

It was announced in 1979 that steps were to be taken to improve Britain's air defence by increasing the number of fighters and their effectiveness. This meant replacing the Lightnings and some of the Phantoms by the new Tornado ADV. At the same time the RAF conducted a review of its basing policy, to determine whether its stations were best located. As a result of this review, it was agreed that there should be a new Tornado ADV base in Yorkshire. RAF Leeming was selected as the most suitable for development.

Due to a number of delays the major phases of the refurbishment programme

T. Malcolm English looks at the dramatic changes that have taken place to transform RAF Leeming from a training station to a key front-line fighter base.

at RAF Leeming did not begin until 1986, which left precious little time to meet the planned operational date of the first Tornado F3 squadron in 1988. The scope of this work involved three main areas:

A new basic infrastructure: the population of the airfield up until 1986 had been less than 800 people. A marked contrast with the serving population of some 1,800 which is required to operate three squadrons of Tornado F3s. Accommodating so many people, plus their families, required a major building project. Single accommodation has been increased by the construction of six new barrack blocks while the existing old-fashioned, cottage-style married quarters have been replaced by 310 brand-new quarters on base. In addition, all of the basic services such as electricity, water and sewage have either been totally refurbished or replaced by new facilities. High priority has been given to developing sports and social amenities, including a new physical recreation training centre (PRTC) which it is hoped will be completed by the end of the year.

Airfield facilities: all of the airfield facilities have been refurbished including the main runway, parallel taxiway and all the manoeuvring areas, which have been levelled and resurfaced. During 1987, while the runway was closed Leeming's role as a MEDA (military emergency diversionary airfield) was taken over by RAF Linton-on-Ouse. A new air control tower has been built to give an improved working environment and an uninterrupted view of RAF Leeming's 2,300m runway. The Tower, which because of its appearance has been nicknamed 'Happy Eater' after the many restaurants of that name which serve the adjacent A1 road, will be fully commissioned in September 1989.

The scale of the building programme is such that it would be very difficult for

No XI Squadron F3s on the flight line.

Photographs T. Malcolm English unless otherwise credited.



anyone who knew the station in the 1960s or 70s to recognise it. Just about every grass area has been built on and almost every existing building has been refurbished. A notable exception is the station church, which is still in its World War II Nissen Hut.

The station has had to build its ground defences from scratch. One of the banes of any station's life are guard posts, which have traditionally been built from sand bags and earth mounds. Construction is very man-power intensive, and will only last a year or so before the ravages of weather

require them to be rebuilt. The RAF Regiment officer at Leeming has designed a two-man bunker which is made from a length of preformed concrete sewer pipe. Known as the Yarnold bunker, it is easy to erect and has been cleared ballistically against small arms fire by the Army at Catterick.

Hardening programme: in common with other front line stations, RAF Leeming has been hardened to protect essential facilities. This programme includes two HAS (hardened aircraft shelter) sites, hardened personnel shelters, protected briefing facilities, wing operations centre and alternate wing operations centre. Two squadrons will normally operate from the two HAS sites whilst the third, No XI Squadron, is likely to deploy in wartime to a forward operating base in support of

maritime operations. That said, there is sufficient space within a single HAS to house two Tornado F3s. In peacetime, No XI Squadron operates from a hangar.

Although RAF Leeming is not the only station to have worked-up Tornado F3 squadrons, the Station Commander, Group Captain John Rooum, is proud of the fact that it was the first time all three elements—infrastructure, airfield facilities and hardening—had been introduced concurrently with the operation of

RAF Leeming's new control tower, nicknamed the Happy Eater after its A1 neighbours.



External pre-flight checks complete, the pilot of a No XI Squadron Tornado F3 climbs into the cockpit.



a new aircraft. This was a unique achievement, made more remarkable by the short period of time available.

The first Tornado squadron to form at RAF Leeming was No XI Squadron on 1 July 1988. This was followed, on 3 January 1989, by No 23 Squadron. The third (No 25 Squadron), will start its work-up in the summer of 1989. No XI Squadron was declared operational in November 1988.

No 23 Squadron will be declared an operational squadron

this autumn and by the end of the winter RAF Leeming will have all three Tornado F3 squadrons operational.

Tradition dies hard, even on a station with so many new facilities and already there is a friendly rivalry between the squadrons. No XI Squadron is proud of its achievement in reaching operational status within only four months and the squadron's commanding officer, Wing Commander David Hamilton, took obvious delight in pointing out that No 23 Squadron has longer in which to work-up. This was reciprocated by the commanding officer of No 23 Squadron, Wing Commander Neil Taylor. A traditionalist on the subject of

aircraft markings, he is adamant that none of his aircraft will have a flamboyant colour scheme. Wing Commander Hamilton's

Below: Night CAP; a Tornado F3 of No 23 Squadron taxis out of its HAS for a night sortie.



No, not a Tardis, but a Yarnold Bunker. RAF Leeming's answer to the traditional earth and sandbag bunker.



A Tornado F3 of No XI Squadron on the flight line.





Sir David Craig unveils a plaque to commemorate the Official Opening of Leeming as an air defence fighter base watched by Gp Capt John Room, the Station Commander. RAF Leeming



Air Chief Marshal Sir David Craig — Chief of the Air Staff inspects the Guard of Honour accompanied by Gp Capt John Room at the Official Opening Ceremony on 10 September 1988. RAF Leeming

aircraft, tail code 'DH', has a black fin as did his predecessors' Lightning when XI Squadron was at Binbrook.

The majority of the aircrews joining the squadrons have previous air defence experience. The remainder are ab initio first tourists while the groundcrew are mostly drawn from Tornado GR1 squadrons. Although the Tornado F3 is straightforward to fly, with well harmonised controls, the highly computerised systems are unfamiliar. So, whilst the basics are the same, the system interfaces are different.

As an aid to aircrew training, RAF Leeming has a full-mission, fixed-base simulator. Built by Singer Link Miles and Redifon, it is used to train aircrews in all operational procedures, including emergency drills.

During the work-up period, training is carried out from RAF Leeming and also on deployments away from base. These detachments are primarily required to carry out specialised training but they also allow the squadron to practise necessary procedures. Typical of the deployments are those to Decimomannu, Sardinia, for DACT (dissimilar air combat training); RAF Valley for MPC (missile practice camp) where live Sky Flash and Sidewinder missiles are fired; and to RAF Akrotiri, Cyprus for APC (armament practice camp) to practise firing the Tornado F3's 23mm Mauer cannon against banner targets towed by the Canberras of No 100 Squadron.

The Tornado F3 has been found to have a particularly effective weapon system in the 23mm Mauer cannon. Compared with the Lightning and Phantom, the gun is more accurate and the weapon system more sophisticated, thus providing much better results. The scores obtained by No XI Squadron on its first APC were quite exceptional. Less than half the usual number of training sorties were needed to qualify the squadron and the average scores were more than twice that required for the crews to meet ACE (Allied Command Europe) standard.

Other advantages that the Tornado F3 has over previous generation air defence aircraft are its improvement in endurance, cockpit environment, communications and navigation. These were appreciated by the crews of No XI Squadron when, within two

months of the start of its work-up programme, the squadron took part in Exercise *Teamwork*, a major NATO maritime exercise. This entailed flying average sortie lengths of seven hours out over the Norwegian Sea and the North Western Atlantic.

On such long sorties, the cockpit environment makes all the difference between an exhausted and a combat capable crew. The Tornado F3's communications equipment was found to be invaluable during operations with Boeing E-3A AWACS (Airborne Warning And Control System) aircraft and a German ship, which provided fighter control. Similarly, the twin inertial platforms enable the Tornado to navigate to a tanker 650 miles (1040km) from RAF Leeming without assistance from ground radar stations.

Engineering is carried out at two levels: first line servicing, such as refuelling, aircraft turn round routine component changes; and maintenance. They are performed by the squadron engineers and the Engineering Wing respectively, the latter comprising four squadrons: Mechanical Engineering (Air), Mechanical Engineering (Ground), Electrical Engineering and Engineering Operations. The level to which maintenance is carried out varies depending on the system concerned, but can go down to component repair. With the engine, for example, the Wing can change individual turbine blades and has the facility to test the Turbo-Union RB199 after re-assembly. In comparison, some avionics units are only tested for serviceability and if they fail are sent to Maintenance Units elsewhere.

One of the first priorities in the station build-up programme was to foster relations with the local communities, in particular to explain what the Royal Air Force was doing at Leeming, the importance of the base and to reassure local residents about its impact. This is achieved through formal liaison committees and informal links within towns and villages.

Several years ago RAF Leeming was given an illuminated address by Northallerton, a close relationship which is retained to this day. More personal links are being forged by the operational squadrons. For example, No XI Squadron

has adopted the town of Bedale and No 23 Squadron is developing a link with Ripon. These associations include supporting particular charities within these towns and villages.

With such a high performance aircraft the opportunity for noise abatement procedures is somewhat limited, but every effort is made to limit disturbance to the local population. For example, for a trial period the original climb-out has been modified by a course away from Pickhill at 500ft to see if this reduces the noise over the village. In addition flying after 23.00 hr is kept to a minimum. After this time aircraft will land off a 'straight-in' approach.

Sharing the station with the operational squadrons is the Northumbrian University Air Squadron and No 11 Air Experience Flight. These operate Bulldog T1s and Chipmunk T10s respectively. Somewhat surprisingly, considering the North Yorkshire topography, RAF Leeming also has a Mountain Rescue Team. That said, although there are few mountains in the area, there is plenty of inhospitable open moorland. The team played a significant role in the rescue effort in the aftermath of the Lockerbie and M1 air disasters. Boasting the only purpose built MRT quarters in the Royal Air Force, the Team has five permanent staff and 20 volunteer members and covers the area from the Scottish border to the Peak district. Also based at RAF Leeming is No 234 Field Squadron Royal Engineers. A volunteer force, whose wartime task is that of airfield damage repair with the aim of keeping the airfield operating after an attack.

Arguments for and against single- and two-seat fighters have raged for years but there is no doubt in the minds of the Tornado F3 pilots as to the benefits of a two-man crew. Whilst a single seater may be capable of performing most tasks in peacetime, intercepting an evading target at low-level on a dark, wet night over the North Sea is made easier with two minds and two sets of eyes on the job.

RAF Leeming has risen from the mud in a unique regeneration to produce a fine new air defence base. Fighter aircraft are back in North Yorkshire after 30 years to strengthen the UK's air defences. In the Tornado F3 RAF Leeming has the ideal aircraft for bridging the Humber-Forth Gap.

GOODBYE JP

Peter R. March



There can be few current RAF pilots who have not flown one or more of the Jet Provost variants during their flying careers. In fact the majority of today's squadron pilots will have received their ab initio training on the JP as it has equipped the RAF's basic Flying Training Schools for the past 30 years. This year marks the beginning of the end for the jet trainer, now in the twilight of its record service with the RAF, as the new turboprop Tucano starts to replace it. No 7 FTS at RAF Church Fenton is the first School to retire its Jet Provost T3As and T5As through this summer and autumn. To many it will appear that the RAF has decided to turn its back on the practice of 'all through' jet training that it first introduced to the world three decades ago.

While Hunting Percival Aircraft was working on the production of the RAF's new Provost T1 piston-engined trainer in 1951, unofficial discussions were already being held with Flying Training Command on the possibility of a basic jet-powered trainer. Developed from the Provost the new aircraft would retain docile flying qualities and slow landing speeds, but in handling techniques would need to be more representative of the front-line aircraft that the trainee pilots would eventually have to fly. The general view was that too much time was being spent during the initial flying training period on perfecting three-

point landings and acquiring the handling skills unique to propeller driven aircraft, which might well have to be 'unlearned' when the pilots converted to the jets at the advanced flying stage and on into front-line service.

In 1952 Hunting drew up the plans for a jet engined version of the Provost with a tricycle undercarriage. With the same side-by-side seating and airframe configuration, the private venture Jet Provost T1 was ordered into limited production by the Ministry of Supply for the RAF in March 1953. A prototype and nine pre-production aircraft were to be used to test out the concept of 'all-through' jet pilot training. Powered by an Armstrong Siddeley Viper turbojet, the prototype Jet Provost T1 XD674 was successfully first flown 35 years ago on 16 June 1954.

Nine of these pre-production jet trainers (XD675-680, XD692-694) were delivered to the RAF in 1955 for evaluation. During the first phase the T1s were extensively flown for a total of 111 hours by Central Flying School instructors, who produced a syllabus for ab initio training. This was then tried out in a comparative trial at No 2 FTS, RAF Hullavington. Two courses of students were started together in August 1955, one group on piston Provosts the other learning on Jet Provosts. The distinction of being the first pupil to solo on the jet went to Pilot Officer R T Foster on 17 October

Left top: The piston-engined Provost T1. Andrew March Middle: The first Jet Provost T1. Hunting Left: Prototype Jet Provost T3. Hunting Below: No 7 FTS Jet Provost T3A and T5A. Peter R. March





Jet Provost T1 with the 1958 CFS Sparrowjets team. Peter R. March



No 3 FTS Jet Provost T4s flying from Leeming. Peter R. March

1955. During the following two years 50 students were taken into the jet training course and only one of these failed to reach solo standard. The CFS Examining Wing reported that "Compared to the average student, the jet-trained pilot has, in a shorter time, achieved a more dextrous and better mental approach to the art of modern flying".

The successful outcome of these trials led to the announcement in Parliament on 8 February 1957 that "the evaluation trials have shown that ab initio flying training on jet aircraft had definite advantages, and it has therefore been decided to establish this form of training throughout the RAF's Flying Training Command". An order was placed for the improved T Mk 3 which featured a more powerful (1750lb thrust) Viper 102, short stroke undercarriage, a new clear view canopy, wing-tip fuel tanks and Martin Baker ejection seats. The T3's radio navigation equipment was also considerably enhanced. The first Jet Provost T3 XM346 was flown on 22 June 1958 and 200 were delivered to the RAF over the next three years.

The first flying training school to be equipped with the Jet Provost T3 was No 2 FTS at RAF Syerston, which received its first aircraft in June 1959. The initial student course on the T3 ran between 7 October 1959 and 22 June 1960. This mark of Jet Provost continued to provide the first phase of basic flying training at the RAF's FTSs for the next 30 years. No other basic training aircraft has established such a comprehensive record with the RAF. Early in 1989 some 60 aircraft were still being operated by No 1 FTS at Linton-on-Ouse, No 7 FTS at Church Fenton and the CFS at Scampton. The only significant modification that has been incorporated during its 30 years of service has been the incorporation of more

modern avionics – VOR, ILS and DME, which were fitted in the mid-1970s. Modified aircraft were designated T3As.

Development of the more powerful Jet Provost T4 followed on very quickly. Fitted with a 2500lb thrust Viper 201, 40% more powerful than the turbojet in the T3, the new T4 was flown for the first time on 15 July 1960. With its better climb performance, higher operating ceiling and speed, the new mark was immediately put into production, to be used by the flying training schools alongside the T3 for those parts of the syllabus where its improved performance was urgently needed. A total of 185 Jet Provost T4s was produced by Hunting Aircraft at Luton between 1961 and 1964, the first aircraft entering service in November 1961. The T4's service life with the flying training schools was less than half of that achieved by the T3. Owing to its 'low-high-low' operating regime and higher operating speeds the T4's fatigue life was used up more quickly and a further improved version, the BAC Jet Provost T5 came along to replace it in the early 1970s. A handful of T4s have remained in service with the Central Air Traffic Control School at Shawbury and with No 1 Tactical Weapons Unit at RAF Brawdy.

The main drawback of the two production versions of the Jet Provost was that neither of them had pressurised cockpits, which meant that there was a limit to the amount of upper air training that the T4 could be used for. So the manufacturer set about designing a pressurised version, using the same 2,500lb thrust Viper 201 as in the T4, and making other refinements in the light of five years operating experience with the RAF. The prototype Jet Provost T5 XS230 (a T4 conversion) was flown for the first time on 28 February 1967. In appearance it was noticeably different from its predecessors.

The wing-tip tanks had gone, as additional fuel could be carried internally and more significantly the cockpit, nose and canopy had been re-designed. Longer by 14in, the nose was more streamlined but the cockpit, with its two section canopy, was more bulbous.

The RAF ordered 110 Jet Provost T5s in 1965, to be built by the British Aircraft Corporation at Warton. The first of these was delivered 20 years ago, to the CFS at Little Rissington, on 3 September 1969. It subsequently went on to replace the T4s at the basic flying training schools. Like the T3, the T5 was given an improved avionics fit in the mid 1970s and the modified aircraft were re-designated T5As. They are currently being used by Nos 1, 3 and 7 FTSs, the RAF College Cranwell, the CFS and No 6 FTS at Finningley. The latter employs the T5B for training navigators who are going on to RAF front-line fast jets. Other than at Cranwell which has no T3As, the T5A is used for the second phase of basic flying training.

As well as making its indelible mark on generations of RAF student pilots, the Jet Provost has been brought to the public's notice by its use for aerobatics. No-one attending airshows through the 1960s and 70s would have missed the precision aerobatics from RAF solo performers or the formation gyrations of such teams as *The Gins* and *The Blades* (1 FTS), *The Macaws* (CAW Manby), *The Poachers* (RAFC), *The Vipers* (2 FTS), *The Gemini Pair* and *The Swords* (3 FTS) or the famous CFS *Red Pelicans*, predecessors of the *Red Arrows*.

The first RAF Flying School to lose its Jet Provosts is No 7 FTS at Church Fenton, North Yorkshire. This FTS first operated Jet Provost T3s/T4s between April 1962 and November 1966, and T3As/T5As since April 1979. It provides a basic flying training course with 93 hours flying over 27 weeks

The T4 was used for low-high-low training. Peter R. March



Jet Provost T5s were flown by many RAF aerobatic teams. Crown copyright



on the Jet Provost T3A and a further 57 hours in 15 weeks on the T5A for fast jet pilots, along with other courses for multi-engine and helicopter pilots. The Headquarters Squadron of No 7 FTS also provides refresher flying with the Jet Provost, for pilots returning to flying duties from ground tours. During this summer Church Fenton will see the arrival of the first of its 21 Tucanos, initially to train the instructors and in the autumn to take over from Jet Provosts for student training. A further five Tucanos will later be added for the Refresher Flying Flight.

Wing Commander Jim Bayliss, Chief Flying Instructor of No 7 FTS, is philosophical about the change. He views the Jet Provost as having been a very successful trainer which is now in need of replacement. It has proved itself to be rugged and reliable, versatile, simple and relatively easy to fly. However it has a very high fuel burn. The JP's Viper is more thirsty than the Hawk's engine and uses nearly eight times that of the Tucano's Garrett TPE 331 turboprop. It can operate across both slow and high speed regimes but the T3A is noisy above 230kt and has a poor rate of climb. It has been a good aircraft to teach both the early exercises on the effect of controls, stalling and circuit work, and through to advanced flying at low-level, navigation and formation exercises. It is steady as an instrument trainer but has poor instrumentation and cockpit layout by modern standards. Because the Jet Provost is such a straightforward aircraft in the basic flying training role, it is difficult to introduce the necessary 'overload' on the student to stretch his capacity.

The big difference between the JP and Tucano is of course the pilot/instructor seating arrangement. The advantage of side-by-side seating is that the student can actually see what the instructor is doing and just as important, vice versa. The student can look at instruments pointed out by the instructor, who in turn can see that the student is adopting good cockpit habits. The disadvantages include the width of the instrument panel where there are single instruments on one side only and the view out of the cockpit is restricted. In the Hawk and fast jets that the student is likely to progress onto, he will be in a tandem cockpit.

As the Jet Provost/Hawk/Tornado through jet training pattern has been so successful, is the introduction of a turboprop at the first stage going to make a significant difference? Perhaps not from the instructors point of view, but it certainly will as far as the engineers are concerned. The Jet Provost was designed around the technology of the late 1950s. It has been rugged, reliable but is fast wearing out. The highest time T3A at 7 FTS at the turn of this year had flown nearly 9000 hours and made 28,392 landings. The basic aircraft, if it had been somewhat younger, could have been re-engined with a modern turbofan, given a 1980s cockpit, instruments and avionics and been set to deliver the training package for the next 20 years. But that was not to be. Over the next two years the Tucano T1 will quickly take its place and we will say good-bye to the faithful JP for pilot training.



Above and Below: Jet Provost T3A and T5A operating from Church Fenton.



Jet Provost T5A XW327 No 7 FTS.



Jet Provost T3A XM425 No 7 FTS. Photographs Peter R. March



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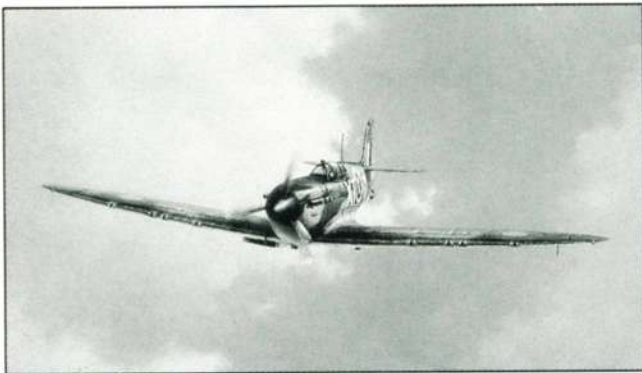
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Six of No 28 (AC) Squadron's Wessex HC2s fly past the impressive Hong Kong waterfront. JSPR Hong Kong.

A HELPING HAND IN

HONG KONG

With 1997 and the return of Hong Kong to the Chinese Authorities approaching, *Sue J. Bushell* recently visited Sek Kong to see the work of No 28 (Army Co-operation) Squadron, which provides the Royal Air Force airborne presence. Equipped with Wessex HC2 helicopters, the squadron is tasked with a wide variety of roles in support of the Army and the Hong Kong Police Force as well as mounting search and rescue missions, performing fire fighting duties and providing assistance to the local community.



No 28 (AC) Squadron was for many years resident at Kai Tak International Airport, in the harbour area of Kowloon, where it had taken up residence after moving from Malaya in May 1949 at the time of the Chinese civil war. Increased airline use of the airport, coupled with its unusual location and consequent lack of land for expansion, resulted in overcrowding, and No 28 (AC) Squadron moved from Kai Tak on 17 May 1978 to RAF Sek Kong in the New Territories, some 20 miles or so distant. Here it is co-located with the Headquarters of 48 Gurkha Infantry Brigade at Borneo Lines, its Wessex helicopters sharing the facilities with the Scouts of No 660 Squadron, Army Air Corps and the local Parachute Club. The Hong Kong Aviation Club also uses the airfield for training purposes due to the intense activity at Kai Tak, and aircraft of

the Royal Hong Kong Auxiliary Air Force are regular visitors.

No 28 (AC) Squadron has a long record as a fighter squadron, and has not been resident in the United Kingdom since 1920 when, after service in Italy during World War I, it was temporarily disbanded at Eastleigh. It was reformed three months later at Ambala in India with Bristol Fighters, and remained in that country engaged on internal security duties in the region of the North-West Frontier until the outbreak of World War II. Its Bristol Fighters were replaced successively by Wapitis and Audaxes.

Service in World War II was in South-East Asia, first in Burma until that country was overrun, then back to India and out to Burma once more from January 1943. At the close of hostilities, it was despatched to Malaya, remaining there until called to



Much of the terrain in the New Territories is extremely hilly. XT673/G performs one of the squadron's usual tasks – transporting soldiers around the countryside.



The Wessex can carry useful loads underslung on a hook, in this instance food and ammunition. Photographs Sue J. Bushell unless otherwise credited.

XT605/E receives attention from maintenance crews on a rare day when it is not required for flying duty. The unit works its aircraft hard.



Hong Kong in 1949, where it has been resident ever since. The squadron lost its fighters (Hunter FGA9s) in January 1967 when it was disbanded. Rotary wing equipment in the shape of the Whirlwind HAR10 arrived in 1968 when No 28 was reformed at Kai Tak on 1 April. The first Wessex HC2 arrived as sea freight towards the end of 1971 and following work-up with the new type, the Whirlwind made its last flight with the squadron on 29 July 1972. Since then, only one Wessex has been lost in an accident, when XR500 struck the waters of Mirs Bay and sank on 19 April 1979.

By front-line standards No 28 is a small squadron with a complement of only 29 personnel. Unusually, the engineering element does not come under the control of the Squadron Commander, Squadron Leader Gordon Evans, but is a separate entity. Sek Kong's air traffic controllers, who number nine at present, do however form part of No 28, a unique feature within RAF squadrons. At the present time, the squadron has ten pilots, one navigator, nine crewmen and one clerk on strength, in addition to the air traffic controllers.

The squadron, which is part of Strike Command, comes under the jurisdiction of the Commander Royal Air Force in Hong Kong, Group Captain Hamilton-Rump, who is in overall control of approximately 260 serving RAF personnel, providing a full range of services including medical care. Of these personnel, 15 are stationed at Kai Tak where they act as an Airport Unit. They deal with the arrival and departure of the visiting RAF aircraft, such as VC-10s (usually two per month) and Hercules, as well as handling the service personnel who transit through the airport on their way to and from the United Kingdom, usually on scheduled services operated by British Airways.

Of the eight Wessex on strength with No 28 (AC) Squadron, at any one time one will usually be undergoing major servicing while maintenance work on the other seven is carried out as and when necessary. The squadron performed three

Royal flights during 1988, and this necessitates preparing the aircraft to a high standard of serviceability. In addition a second Wessex had to be provided to act as backup, just in case something went wrong with the first helicopter.

No 28 (AC) Squadron's Wessex have flown an average of around 7,500 hours and are at least 20 years old. Spares have to be shipped from the United Kingdom. A major problem facing the engineering staff at Sek Kong is the environment in which the Wessex are operated. Hong Kong has a tropical climate and corrosion is a constant problem. There is a lot of salt water about with the result that the helicopters need to be washed regularly to prevent corrosion getting a hold. The climate — hot and sticky in summer, pleasantly mild in winter — is classified as 'hot and high'.

In the early 1970s the Wessex fleet was exchanged for examples from the UK, while two more 'new' examples were acquired last year. The unit sent two aircraft to Maralinga in Australia in 1987 to inspect the nuclear test site and these were returned direct to the UK at the end of the operation, rather than returning to Sek Kong. They were replaced by two aircraft formerly with No 84 Squadron at Akrotiri, which now operates the ex Fleet Air Arm HC5 variant of Wessex.

The small size of the unit means that the crews get to perform a wide variety of interesting and demanding tasks. A standard duty is the twice-a-week, thrice-daily shuttle that No 28 (AC) Squadron operates to HMS *Tamar* on Hong Kong Island, where the British Forces Headquarters is situated. The short flight is a time-efficient way of transporting people to and from important meetings — the drive from Sek Kong to Hong Kong Island can easily take two hours on the crowded streets, while the Wessex can accommodate more than a dozen passengers each trip. Tasking for No 28 is also done from the Joint Air Tasking Cell. At present many assignments are undertaken for the British Army, although duties for the

Mercy missions are often flown within the colony. JSFR Hong Kong.



Royal Hong Kong Police are increasing and can be expected to be expanded further as 1997 approaches.

Hong Kong is the major overseas base for the Gurkhas and all basic Gurkha training is done there. The Gurkhas need to be transported around the territory to the many ranges and outposts dotted around. They can be dropped into position by Wessex in a matter of minutes, precluding a long march over difficult terrain. In addition, their supplies of ammunition can be replenished with little effort, as the Wessex's underslung load capability enables the food and ammunition to be carried in a net below the fuselage. To prevent the accidental egress of civilians onto live ranges, red flags are hung around the perimeter in conspicuous sites. At the weekends and on public holidays, the Wessex crews are tasked with the hoisting and lowering of these flags, enabling the local population to visit ancestral grave sites situated in the hills that make up the ranges. The flags are replaced whenever an exercise is imminent.

As well as the two airfields — Kai Tak and Sek Kong, there are more than 200 helipads dotted around the Territory, of which in excess of 100 are authorized for use at night. All of these landing sites have to be visited regularly to ensure that the condition of the surface is good. Any deviation from the normal is noted so that the squadron records can be updated.

In winter, Hong Kong's dry atmosphere and the local tradition of lighting small fires on ancestral graves, results in many fires in the hills. No 28 (AC) Squadron is regularly called to assist in dousing these, a task performed using an underslung 250-gallon bucket. At the other end of the scale, when the Territory was struck by Typhoon *Warren* in July 1988, the squadron was called in to rescue local inhabitants from the encroaching floodwater. Mercy missions are flown on a regular basis, including the delivery of sick patients to hospital, and the rescue of injured hill climbers. Occasionally, pregnant women are

transported to hospital from remote locations, and several babies have been born in the Wessex during these flights. Night operations are flown using the powerful Nitesun system, which is fitted to many of the Wessex.

Visits by aircraft carriers such as HMS *Ark Royal*, which visited Hong Kong on 23 August 1988, provides an opportunity to practise deck landings. Just eight days later, the squadron put its search and rescue techniques into effect, when it attended the accident to a Chinese Trident which skidded off the runway at Kai Tak. Five Wessex were on the scene almost immediately, and helped to carry officials to and from the site of the accident. Ditching techniques are practised regularly, although the unit has lost only one Wessex in 17 years of operations in this way, thanks to its twin-engined capabilities. The Whirlwind did not fare so well due to being a single-engine machine, and No 28 (AC) Squadron lost three to ditchings in two years.

Support for the Police is given when it is required, and tasks include transporting officers to outlying islands of the colony where prison camps are situated. In the early 1980s, the Squadron was also heavily involved with the escalating illegal immigrant situation, which has now abated to a trickle. The 22-mile border with mainland China, which follows the course of a river, is fenced and patrolled by the Army and Hong Kong Police on one side and the Chinese Armed Police on the other. Vietnamese refugees are also housed in the Territory pending their repatriation or resettlement.

As 1997 approaches, No 28 (AC) Squadron will begin to slowly wind down as the duties of the Royal Hong Kong Auxiliary Air Force increase. There will undoubtedly be a Royal Air Force presence in the Territory until the day of handover, bringing an end to a relationship that stretches back to September 1945.

At any one time, a Wessex will be in pieces undergoing deep maintenance.





SAFETY FROM THE FLAMES

Report and photographs — *Paul Jackson*

Which is the more common, an aircraft accident or a chip-pan fire in Married Quarters? Fortunately it is the latter — and that fact serves to demonstrate the versatility demanded of the RAF fireman in his daily duties. Whereas in the past, diverse fire-fighting skills were imparted at two separate units, training is from January 1989 onwards being undertaken at a single location — the RAF Fire Services Central Training Establishment (FSCTE) at Manston, near Margate.

It is seldom realised that the vital duties of fire prevention and 'cure' are undertaken in the RAF by locally-employed civilian firemen, as well as servicemen. Until its disbandment on 18 November 1988, the Fire and Rescue Training Squadron at RAF Catterick was responsible for training the latter. Now, this unit has been combined (officially on 1 January 1989) with the former civilian Air Force Department Fire Service school at Manston, in a move to improve efficiency and economy.

The RAF FSCTE traces its history back to

1916, when the Royal Flying Corps took over fire-fighting duties from the Army Fire Service, although it was 1922 before a training school was formed at Cranwell. This was transferred to Weeton, near Blackpool, in July 1940, and to Sutton-on-Hull three years later. In 1959, coincident with a move to Catterick, the civilian training branch of the Fire Services was formed at Manston. Today, there are about 2,150 firemen standing watch over 87 RAF stations at home and abroad, of whom 712 men and 42 officers are home-based civilians, while a further 127 men are foreign nationals based abroad.

Overall control of the FSCTE is exercised by the Commandant, Wing Commander John Gritton, in close collaboration with his Chief Instructor, Mr Austin Elleman. Perhaps surprisingly, much of the Establishment is housed in ageing wooden huts, although that is being rectified by a building programme which will reach its culmination in the summer of 1991 when a £4 million training centre is opened.

Meanwhile, the construction work that this involved is appreciated in the relatively high unemployment area of Thanet.

Economies at the combined FSCTE have begun immediately with the overall reduction in instructional staff by 11 to a new total of 52. Some courses have been integrated, though 14 different training schedules still remain. This year, about 950 students — compared with 517 in 1988 — will pass through Manston in 64 intakes: 38% of them RAF; 32% RAF-employed civilians; 18% MoD (Procurement Executive) civilians; and the rest from the Royal Navy, British Airways, British Airports Authority and elsewhere.

RAF students reporting to Manston will first have received their eight weeks of basic training alongside other non-commissioned recruits at Swinderby, near Lincoln, in the rank of Aircraftsman. After a further eight weeks at Manston on the Basic Fireman course, they qualify as a Leading Aircraftsman and are posted to a station with a vacancy. In contrast, civilians

Main picture: *Side line hoses penetrate to the seat of the fire — in this case a well singed Victor.*

Left: *Staff of Manston's fire school and their training equipment, comprising (right to left) a Hawker Hunter rescue training airframe, TACR Mk 2 Rapid Intervention Vehicle, Mk 10 Primary 2 and Mk 11 Primary 1 foam tenders.*

are recruited locally by certain RAF bases (including non-flying radar stations, storage units and even USAF-occupied Wethersfield) to man their fire sections. Civilians return from Manston with the grade of Fireman, having studied shoulder-to-shoulder with their services colleagues. The first such combined course began on 25 January 1989.

Career advancement for both involves further study and periodic returns to Manston for advanced training and refresher courses lasting from one to five weeks. After passing the stages of Corporal or Leading Fireman and Sergeant or Sub Officer, they may be commissioned. Here, the parallel ends, for whilst the civilian officer remains a fire-fighter, the military officer is commissioned into the RAF Regiment and may find himself (for example) in charge of a battery of Rapier missiles, attempting to destroy aircraft, not save them. Conversely, as the Regiment has been responsible for the Fire Service since 1955, officers in charge of fire sections at RAF stations may not be professional firemen. They thus rely heavily on their senior NCO or Sub Officer for day-to-day operations, as there are only five qualified fire-fighter officers in the Regiment.

With some exceptions, such as turntable-ladder work, the RAF fireman must have the same training as his counterpart employed by local councils, *plus* specialised knowledge of aircraft crash rescue. Classes at Manston are therefore extremely diverse, covering such far-removed subjects as the fuel systems of certain aircraft types; the techniques for extinguishing a chimney fire; and calculation of the legal seating capacity of a place of entertainment with a given number of fire-exits.

Greatly though the fireman is appreciated in his many roles, aviation enthusiasts visiting Manston give little thought for the realistic buildings and smoke-chambers which are regularly used in training. The instructional aids which catch their eyes are the time-expired airframes. Apart from a few representative types used to train firemen in the techniques of releasing an incapacitated crew, Manston's battle-scarred squadron of aged aircraft is slowly being burnt to ashes.

About 25 aircraft in various stages of decrepitude are employed by the FSCTE at any one time, of which three are in the burning area. Others serve as subjects for other forms of training until they, too, become so dishevelled that burning is the only useful option remaining. Even so, every airframe is 'torched' on numerous occasions before it finally becomes unrecognisable.

Students operate the RAF's standard fire appliances. The smallest of these is a



modified, six-wheel RangeRover known as the RIV (Rapid Intervention Vehicle) or TACR (Truck, Airfield Crash Rescue) Mk 2. Its role is to race to the scene of an aircraft accident and assist the crew. Following it will be the heavy Primary 1 and/or slightly smaller Primary 2 tenders, newest of which are the Mk 11 and Mk 10 appliances — each of which has a foam cannon, called the monitor, on top of the cab. From its high vantage point, the latter knocks-down the major element of any blaze, whilst two side-lines (hoses) from each appliance are used to extinguish fires in the more inaccessible corners of the airframe.

Each RAF station has its own requirements for fire equipment. Bases regularly receiving large, fuel-laden passenger transports will be Category 7, demanding four Primary 1 vehicles, an RIV and 13 personnel; but a small installation on weekend stand-down might require the Category 1 equipment of a single RIV and three men. An average Fire Section complement would be the Category 4 state of a Mk 10, a Mk 11, an RIV and seven firemen. Equipment at Manston is painted in traditional red, whereas that on operational stations is camouflaged drab green.

Above (top): *Side-by-side on Manston's fire training area are a battered Viscount airliner and a newly-built house to give student firemen experience of domestic fires.*

Above: *Rescue training airframes are not 'torched' until they can serve no other purpose. Here a Whirlwind helicopter rests on the fuselage of a Devon light transport, whilst the Super VC10 fuselage in the background awaits modification to a smoke trainer in which breathing apparatus will be used.*

Below: *The monitor of a Mk 11 tender sprays foam on a training fire whilst instructors look on.*

First graduates of the new FSCTE's realistic and comprehensive courses are now taking their places at RAF stations, joining military and civilian counterparts trained at the previously separate establishments. In the past, prompt action by the RAF Fire Service has saved countless lives and untold millions of pounds' worth of aircraft. So, like their forebears, these newly-qualified RAF firemen will be expected to display courage and fortitude in the face of a phenomenon which, despite being amongst man's oldest friends, remains one of his most fearful enemies.







MULTI ROLE HAWK

The RAF's trainer with talons



Above: Red Arrows Hawk in wartime configuration. BAe

Peter R Foster

Conceived as a replacement for both the ageing Hawker Siddeley Gnat and Hawker Hunter, British Aerospace was perhaps surprised at the speed with which the Hawk has become accepted as one of the most versatile subsonic aircraft in the free world.

Designed to fit in with third generation jet aircraft thinking, the speed range of the Hawk fell directly between that of both the Gnat and Hunter. In doing so, it gave the Royal Air Force the ability to streamline its flying training syllabus, taking the student straight through the tactical weapons stage without a necessary pause between two types.

Entering service with the Central Flying School at RAF Valley on 4 November 1976 with the delivery of aircraft XX162 and XX163, the Hawk was soon to establish itself as a forgiving trainer, yet one to be respected. The ability to pull up to 7g gave the Tactical Weapons Units a platform from which realistic scenarios could be planned and flown without the constant threat of overstressing the jet. It was therefore inevitable that, following the introduction of the first two aircraft, XX187

and XX190, to the TWU at RAF Brawdy on 2 December 1977, the possibility of giving these second-line aircraft an aggressive rôle would arise.

At the end of the 1970s the Hawk's sales potential was almost outstripping the reduced British Aviation industry's capabilities, with orders from Finland, Kenya, Indonesia, Zimbabwe, Dubai, Abu Dhabi, Kuwait and Saudi Arabia. The growing order book was putting BAe back on a par with the days when companies such as Hawker were monopolising Europe and the Middle/Near East air forces with their fighter sales. Furthermore, most, if not all, of these countries saw the immediate potential in the versatile Hawk for operational rôles beyond training. It was not long before the RAF also began to realise that the Hawk's manoeuvrability was an asset to be exploited in a gap which was becoming a growing problem — 'air defence'.

From the outset of British fighter design the requirement has been Air Defence of the United Kingdom. In the days of the Spitfire through to those of the Lightning, the manned bomber was seen as the

Left: Hawk T1As from 2 TWU, RAF Chivenor. Phil Boyden BAe

main threat, with the tactics being to intercept/destroy and then re-arm. The Tornado went further in realizing that the threat had to be met at ranges far from our shores whilst the ability to loiter on Combat Air Patrol (CAP) increased its effectiveness. However, even before the Tornado ADV was in service it was appreciated that in designing the Tornado for stand-off defence the ability to engage an enemy in close combat might be reduced. This was partly offset by the increased effectiveness of the Bodenseewerk AIM-9L heat-seeking missile with its all-aspect capability. However, the Tornado and Phantom which equip the UK air defence squadrons could only take four such missiles into a fight along with their radar guided BAe Skyflash and Ratheon AIM-7 Sparrows. Equally, there is a limit to the number of these potent interceptors available so the idea of the mixed fighter force (MFF) was conceived.

Nato had already developed the integrated MFF concept with the older fighters equipped with superior radar guided missiles encountering the threat head-on and at some distance, being supported by the more agile new generation fighters like the F-16, for close combat.

The UK's Air Defence Region (UKADR) stretches from as far north as the coastal approaches to Norway and Iceland, to the South-West approaches and the Scilly Isles. The region includes the strategically important 'gaps' such as those between the Shetlands and Faroes, and the Faroes and Iceland.

The integrity of this huge area must be protected from potentially hostile intruders, from its extremities on behalf of our NATO allies right into the UK itself. To achieve this mission, the UK Air Defence System provided by No 11 Group comprises radar stations, airborne early warning (AEW) aircraft (Shackleton AEW2s), long-range fighter aircraft (Phantoms and Tornados) and their attendant aerial refuelling tankers (VC10s and Victors). Nearer to home there are the Bloodhound II surface-to-air-missiles of No 85 Squadron and the airfield defence RAF Regiment Rapier batteries and radar-directed Oerlikon guns.

The resources available to No 11 Group left a gap between the long-range fighters and the Bloodhound missiles. It was here that a dedicated fighter was needed. The Tornado ADV re-equipment programme absorbed a high proportion of the UK's defence budget, and it could not stretch to support the design and production of a second new fighter. The Hawk with its good turn of speed and manoeuvrability was a possible solution. However, as an advanced weapons trainer it lacked all the necessary 'goodies' to enable it to take itself into the fight. But by adapting it to

take and fire the all-aspect AIM-9L Sidewinder missile and then adopting the tactics for the MFF already developed by NATO, the strength of the defence chain could be greatly increased.

Trials of the Sidewinder equipped Hawk T1 were carried out by the Aeroplane and Armament Experimental Establishment (A&AEE) at Boscombe Down, with test missile firing being conducted from Aberporth. Once these had been successfully completed, British Aerospace set about a conversion programme to modify those Hawks operated by the Tactical Weapons Units at Brawdy and Chivenor, along with the Red Arrows' aircraft, to take up this secondary air defence fighter rôle. Designated Hawk T1As, all but the aerobatic teams' aircraft have since been repainted in the standard low-visibility grey fighter scheme. As they



The head of an inert practice missile which gives all the indications of a missile firing without actually leaving the aircraft. The missile fins are removed during normal training.

P. R. Foster

were delivered back into service the Hawks became available for integrating into the Mixed Fighter Force as a secondary and very important air defence element in the UKADR.

Support and training for the Hawk in 'Point Defence' is provided by the crews and staff assigned to the Tactical Weapons Units at Brawdy with Nos 79 and 234 Squadrons and at Chivenor with Nos 63 and 151 Squadrons. The aircrew employed in this rôle are all experienced second and third tourers, coming from a variety of backgrounds. The normal training syllabus includes air combat training (ACT) which serves to increase the staff pilot's proficiency, and is further reinforced by regular exercises.

The basic idea of the Hawk in 'point

defence' is, in the cold reality of the war situation, a way of taking more missiles into the fight without the costly addition of complex interceptors. In setting up an MFF scenario, which regularly occurs for exercises such as 'Elder Forest' and 'Elder Joust', a flight of Hawk T1As are detached to designated airfields where dedicated air defence units are required. Taking a sideways glance at one of the Hawk units during the 1988 'Elder Joust' exercise ably demonstrates the system at its best.

No 63 Squadron at RAF Chivenor is commanded by Squadron Leader Barry Lennon under the watchful eye of the Wing Commander Flying, Russ Morley, and the Station Commander, Group Captain Dick Wharmby. Within the structure of the squadron the establishment allows for a complement of 16 instructor pilots and two navigators. The pilots have come from various front-line types, like, for example Flt Lt Andy Clay whose previous tour was on Jaguars with No 31 Squadron at RAF Bruggen and Flt Lt Marc Gibbon who, like his boss, came from the Lightning world. The Squadron has a Royal Navy exchange officer in Lt Cdr Ken Patrick, who has flown everything from the Swordfish to the A-7 Corsair II whilst the navigators include Flt Lt Jerry Uren with Phantom experience on Nos 56 and 74 Squadrons.

During the exercise held between 4 and 6 October 1988 the squadron detached Hawks to RAF Coningsby to work under the MFF with the Tornados of Nos 5 and 29 Squadrons. Obviously, in a hostile situation, the entire unit would deploy, but for exercise purposes it is kept to a representative number so as not to disrupt the important task of maintaining the flow of new and refresher aircrew through the Tactical Weapons Unit.

After arriving at Coningsby the Hawks have to be integrated into the system and it becomes the task of the station to provide the necessary support for those crews. In a real conflict additional aircrew with recent Hawk experience who are at present in non-flying posts would also be brought in to provide back-up.

During 'Elder Joust' the Hawks were used in their primary rôle as part of the MFF, although they could have been called upon to take up their alternative rôle, acting independently on a day-visual combat air patrol (CAP) for air defence of the base. Working with one of the air defence radars the Hawks are positioned on CAP with a pair of Tornado F3s somewhere off Flamborough Head to meet any inbound threat. For the exercise the 'Orange' forces make good use of the range areas at Donna Nook, Holbeach and Cowden before moving on to their allotted targets, which are invariably the RAF's main assets such as airfields and radar stations. By setting the CAP at such



Bae



Phil Boyden Bae

a position, the defending fighters have a good chance of catching the intruders as they make their way into or out of the area.

This may sound like 'cheating' but to gain air superiority these assets would, in a real war, have to be taken out by the enemy. Routes to and from such targets have only certain logical ways of being planned so as to avoid known threat areas such as the Bloodhound missile chain. Therefore, the GCI controllers at the air defence radar centres have to think and plan accordingly.

Once the CAP has been established, which might be at 6000ft with a 'hot leg' on a heading of 020deg, as the expected threat is from that direction, and a 'cold leg' on the reciprocal bearing of 200deg, the

Hawks stay in visual range of the Tornados and follow them should a contact be gained. The likelihood would be that the four aircraft would be split so that there would always be one radar on the hot leg. It can be expected that warning of an approaching raid will be given from the controlling sector operations centre using information from ground radars, AWACS or a warship out in the North Sea, but it is possible that elements might get through undetected and then it will be up to the Tornado's Foxhunter radar or even the keen eyes of the aircrew to detect them.

The Hawks do not necessarily wait for instructions from the Tornados, although the prime function of MFF is for the defending fighter with radar to set up the intercept. Radar and communications

jamming is of importance in any scenario and during this exercise the Canberra T17s from No 360 Squadron, supported by Mystere 20s from 335 Skv of the Royal Norwegian Air Force and Piaggio PD808ECM's of 71° Gruppo Italian Air Force, attempt to interfere with the defending radars and communications. To counter this, various tactics exist but lie outside the scope of this article. However, if communications are sufficiently distorted then the crews revert to the traditional wing-waggle visual instructions.

The Tornados (or Phantoms) attempt to make a 'Fox 1' intercept indicating beyond-visual range, utilizing their BAe Skyflash and AIM-7E Sparrow missiles, but will then generally not become embroiled in a close air combat situation, leaving that to the Hawks. The Tornados and Phantoms are likely to have used their reheat through the fight and return to the CAP and an attending refuelling tanker so as to employ their radars to better effect. However the Hawks, upon becoming entangled in any fight, have the two AIM-9L Sidewinder missiles and the centre-line gun pack with which to engage the enemy. The chances are that incoming fighter/bombers will be determined to reach their targets and being heavily loaded with fuel and weapons will avoid such a fight. Should they drop their ordnance to commit themselves to such an engagement, then the CAP's work is complete. Equally, should any fighter escort become embroiled with the defending Hawks, then this leaves the more vulnerable fighter/bomber to the defending Tornados and Phantoms.

Modern day tactics dictate that any inbound force will in all probability employ 'sweeping' fighters out in front and it is here that the Hawks' main job lies. If they can tie down these aircraft, leaving the bombers to the Tornados and Phantoms, then the concept of MFF works. It is however up to the controlling agency to identify the threat and to manage its resources accordingly. Ideally, it is better to let such a force go, in order to deploy more missiles against the main threat. The ideal, however, very rarely works. The cost effectiveness of utilizing an aircraft as versatile as the Hawk in the MFF rôle must be borne out by its ability to break up any threat, if not entirely then at least the cohesive package, so that it can be mopped up more easily by those better positioned to do so.

In keeping tactics simple the cost of continuous training is minimised, thus justifying the concept of MFF. The Hawk, when looked at by other air arms to have such potential in its use by the RAF, can only go on to greater things. It is therefore not surprising that the single-seat Hawk 200 is now flying, which sees the 'trainer with talons' turn into a 'tiger with fangs'.



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High School, missile site, Army barracks, yachting marina, prison, housing estate, air cargo centre and giant container port — what have these places in common? All were RAF stations on the day war broke out — their names appear at the end of this feature.

At the outbreak of war there were some 200 assorted aerodromes in Britain, of which 110 were permanent RAF stations, some still incomplete. By May 1945 British aerodromes numbered around 1,000, the creation of which had cost about one billion pounds, a breathtaking sum at that time. Little wonder that Cabinet decisions controlled post-war disposal of such a huge national asset.

Rapid wind-down following World War 1 led to many flying grounds returning to agricultural use with the proviso that the carefully chosen sites might one day be needed again. Buildings frequented by the Royal Flying Corps were in use well into WW2, and some are still visible to this day. A few retained aerodrome sites such as Stamford and Duxford were extensively rebuilt soon after the war before the diplomatic frictions of the mid-1920s set in motion long-maintained features of Britain's air defence policy.

Hitherto the RAF's main task had been to police the Empire. This was now to change radically. Fighter stations were to be established within belts extending north and west from London to shield the south Midland bomber stations at Abingdon, Bicester, Boscombe Down, Upper Heyford and Worthy Down. More fighter stations would ring the Capital, utilising famous sites from the previous war such as Biggin Hill, North Weald and Sutton's Farm, which was renamed Hornchurch. Duxford and Stamford — developed as Wittering — would also become fighter stations, with Digby and Church Fenton to be added later. Vulnerable points such as Dover and

CASTLES OF THE AIR

Michael J. F. Bowyer

Portsmouth would have protection from Hawkinge and Tangmere which were fortuitously placed for the 1940 battles.

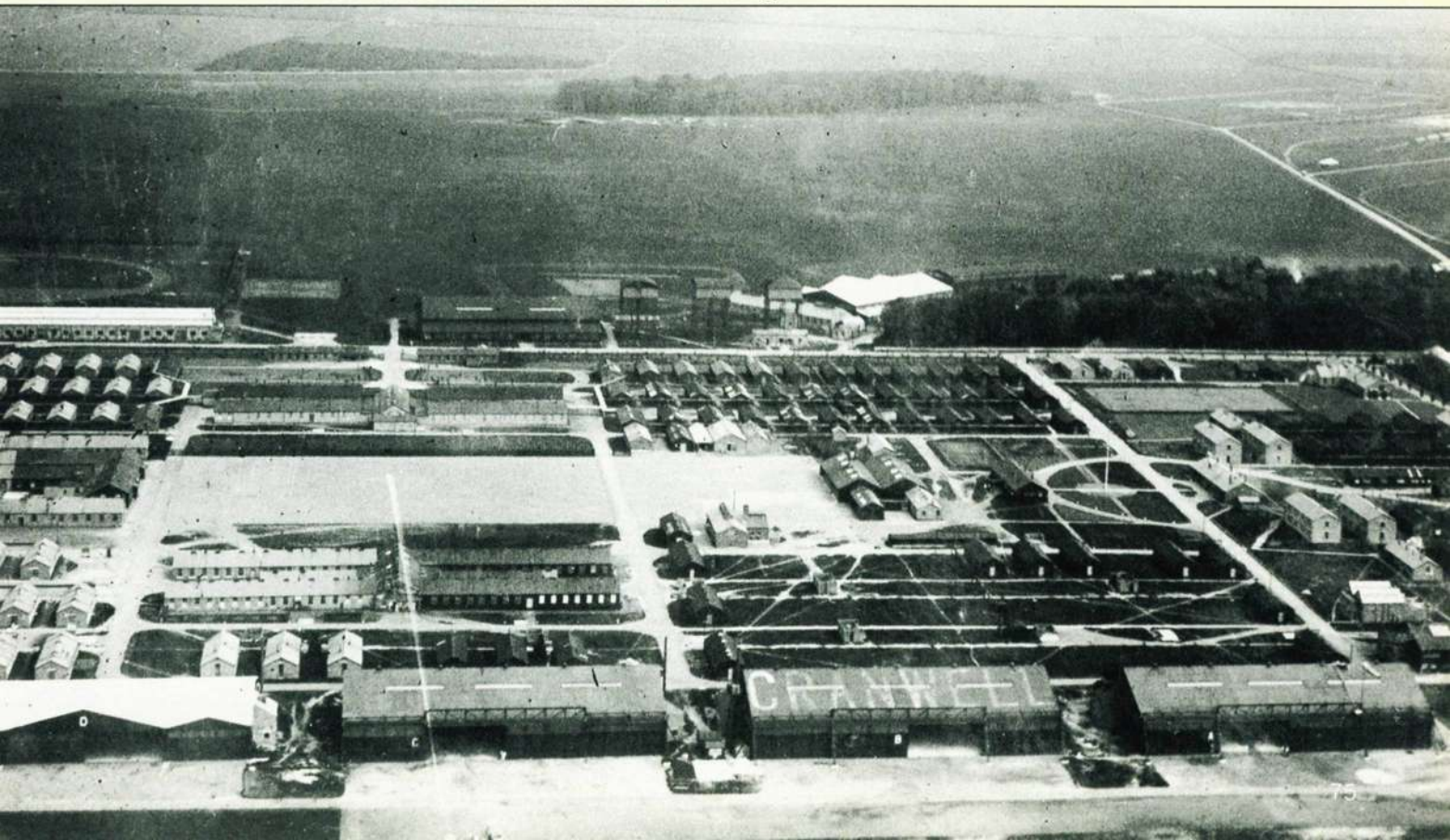
Precise positioning took into account suitability for hefty concrete, stone dash and wooden Belfast Truss hangars and other buildings which would need firm ground for their foundations. Ample flat space not prone to flooding and likely to dry out quickly following heavy downpours was necessary for landing grounds, which tended to be oval in shape to permit landing approaches from all directions. The position of villages and other possible obstructions needed consideration, and close proximity to rail links was essential. Operational, building and maintenance items for many RAF stations were often delivered from the nearest rail depot by steam lorry or even horse and cart. Steam hauled trains found their way into the yard of Main Stores at some stations, such as Felixstowe and Bicester; Army support squadrons were stationed near Salisbury; Calshot and Felixstowe accommodated seaplane squadrons; Leuchars and Abbotsinch held the RAF's controversial torpedo bomber squadrons.

Many home-sited RAF landplane aerodromes of the early 1920s featured oval-roofed wooden Belfast Truss hangars, usually six in pairs plus a single one for major aircraft repair purposes. A concrete apron flanked and fronted them. There was no perimeter track nor a 'control tower' as such, flying being recorded at the watch office hut. Night flying involved lining a grass 'lane' with oil-based flares and a chance or pundit identity light. There was no sophisticated lighting then, although there were ornate lampposts around the camps. Most buildings were of bungalow design, apart from prestigious Station Headquarters which was sometimes topped with a clock tower. 'SHQ' was usually near the guardroom so that those



This WWI-vintage RFC hut still exists at Rendcomb, Glos.

This view of Cranwell in 1923 bears little resemblance to the present day RAF College.



in charge could readily observe all and sundry! Each aerodrome had its main stores, station workshops, parachute section, armoury, engine shop, and MT yard. A sandbank, sometimes enclosed, served as stop butts for gun testing.

Set apart from the Technical Site, the Domestic Site contained the Messes and an 'Institute' (NAAFI to younger folk) where corporals and lower ranks met to enjoy themselves, playing table games and buying 'extras' to enhance official rations. Slate-roofed, red brick houses — terraced or semi-detached — were provided for married men, with detached homes for officers. Stone and concrete open dormitory huts warmed by 'tortoise stoves' were provided for unmarried airmen. With local bus connections, tennis courts and playing fields to hand, the train usually a fair walk away from the camp, the RAF of the 20s and early 30s had plenty to commend it at a time of much unemployment. However, progress was already making demands.

Accommodation at bomber stations designed between 1925-27 was soon deemed insufficient to support squadrons of Heyfords and Virginias, so two-storey barrack blocks accommodating 80 men were erected, usually alongside the sacred barrack square. Airmen's and Sergeants' Messes needed enlarging and stations like Bicester and Upper Heyford were expanded into the 1930s. Their new-look 'A' Type Aircraft Sheds with gabled roofs — factory-style — remain in use. The last of the 1920s chosen aerodrome sites to be developed was Mildenhall and it became symbolic of a new era as its mixed style buildings were being completed when Nazi Germany started to flex its muscle. Mildenhall's incomplete 'A' Type Aircraft Sheds formed an unusual backdrop for the



War-time style control tower with garage for a fire tender or ambulance.

start of the 1934 MacRobertson Air Race and again in July 1935 during the Jubilee celebrations when King George V reviewed his biplane air force at the base. He then transferred to Duxford to witness a memorable flypast, with Heyfords leading a swarm of chattering Harts and Bulldogs, working hard to keep ahead of the nimble Furies.

By 1936 change was apparent everywhere, with Northolt, North Weald, and others following Mildenhall's lead. Distinctive 1934-vintage Georgian-style brick buildings were already under construction at new aerodromes, mainly in East Anglia, Lincolnshire and Yorkshire, to face the growing German threat. Dominant at the bomber stations were 13-bay Type 'C' Aircraft Sheds, 300 feet long and 150 feet wide — fighter stations had smaller versions. Heavy bomber stations had five hangars, medium bomber bases had four and fighter stations two or three. Prefabricated steel frames strengthened their roofing. The hangar gables, usually hipped, were intended to induce bomb skipping, hence their shallow angles of repose. Should a high explosive weapon explode within the building, blast could be

dissipated through huge side windows. Eventuality proved these theories to be partly true as hangar frames survived wartime bombing.

Mid-1930s-built barrack blocks, stores, Airmen's Messes, etc. had sloping roofs. Those completed around the start of the war featured flat roofing of reinforced concrete which was sand-filled above, within a walled area to absorb incendiaries and strafing fire. Such buildings, seen in plenty at Upwood, had less grace than their predecessors whose designs had the support of the Fine Arts Commission.

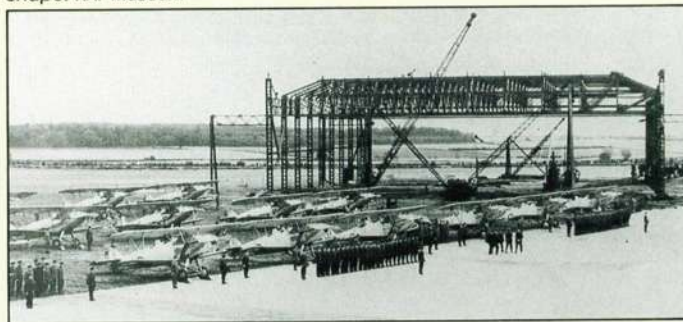
Positioned to the fore of the apron was a new essential, the 'watch office' which was topped by the Duty Pilot's tower to afford him a clear view of flying and ground activity. Surviving examples include those at Wattisham and Bicester. As these new permanent stations came into use so did fast monoplanes which were far more demanding than biplanes, especially when taking off and landing. Longer take-off runs were necessary and concrete runways more practical. Future bombers demanding even longer runs led to novel projects. At Harwell a huge catapult was installed for bomber launching but was never tested; another suggestion was for high-speed bombers to be carried piggy-back fashion and launched from carriers.

Prior to hostilities, aircraft spent each night in protecting hangars, but when the war began they were left outside and dispersed around aerodrome perimeters. Soon, if not already in position, a narrow road had to be laid enabling heavy vehicles to reach aircraft and defensive gun emplacements. Such activity encouraged a new development — the erection of huts among dispersal areas. Camouflage being essential, some aircraft were hidden

Six paired Belfast Truss hangars and a single (for aircraft repairs) at Old Sarum.



RAF Wittering review. In the background, a Type 'C' aircraft shed takes shape. RAF Museum



Since this photograph was taken in 1945, Cranfield has remained relatively unchanged.





A pair of No 64 Squadron Spitfire Vbs inside a protective earth revetment, doubling as an air-raid shelter. IWM



In contrast, 20 years later, another No 64 Squadron aircraft, Javelin XH762, is guarded by blast walls.

among trees. Throwing netting over any machine was a complicated affair that was not much pursued. Hangars too had been netted, but the high fire risk discouraged that practice, so hangars, many of which were finished in white pre-war, were camouflaged.

An extremely important introduction was the 'satellite' airfield, of which Alconbury, in 1938, was the first. Initially little more than large grass fields to which squadrons dispersed for protection, and later for operations, satellites with tented accommodation came into use when the war started. By summer 1940 many were in use for night flying in the belief that an enemy attack, attracted by illumination, would be less harmful to a satellite than at a permanent station.

Necessary protection for fighters and trainers at bleak satellites during winter led to another innovation, the cheap Blister Hangar. It comprised metal panels fitted onto a curved frame 60 feet long and 25 feet deep with canvas curtains at one or both ends and it provided adequate shelter for aircraft maintenance to be carried out. Two 'blisters' could be joined together and varieties with greater span

followed, remaining examples testifying to surprisingly lasting qualities.

Several permanent stations reached completion in 1940. Like Coltishall, Middle Wallop and Leeming, their 'C' Type hangars display an incomplete appearance lacking brickwork around their four corners. Such large hangars, which were costly to build, heat, and blackout, took so long to construct that Sir William Arrol & Co in 1939 were asked to design an 18-bay 300 foot by 150 foot steel framed and panelled curved roof 'J' Type hangar which featured at many aerodromes completed in 1940-41. At Coningsby trials were undertaken to see whether grass could be grown on them easily to provide camouflage. Cutting it proved hazardous so the idea faded. Elsewhere grass almost traditionally covers the cavernous Lamella Hangars built at Aircraft Storage Units, seen for instance, at Brize Norton. ASUs had large curved roof 'D' Type Hangars, examples of which also remain at Brize Norton and Little Rissington — the latter station is partially constructed using local stone which helps it to blend with its picturesque surroundings.

February 1940 brought an unpleasant

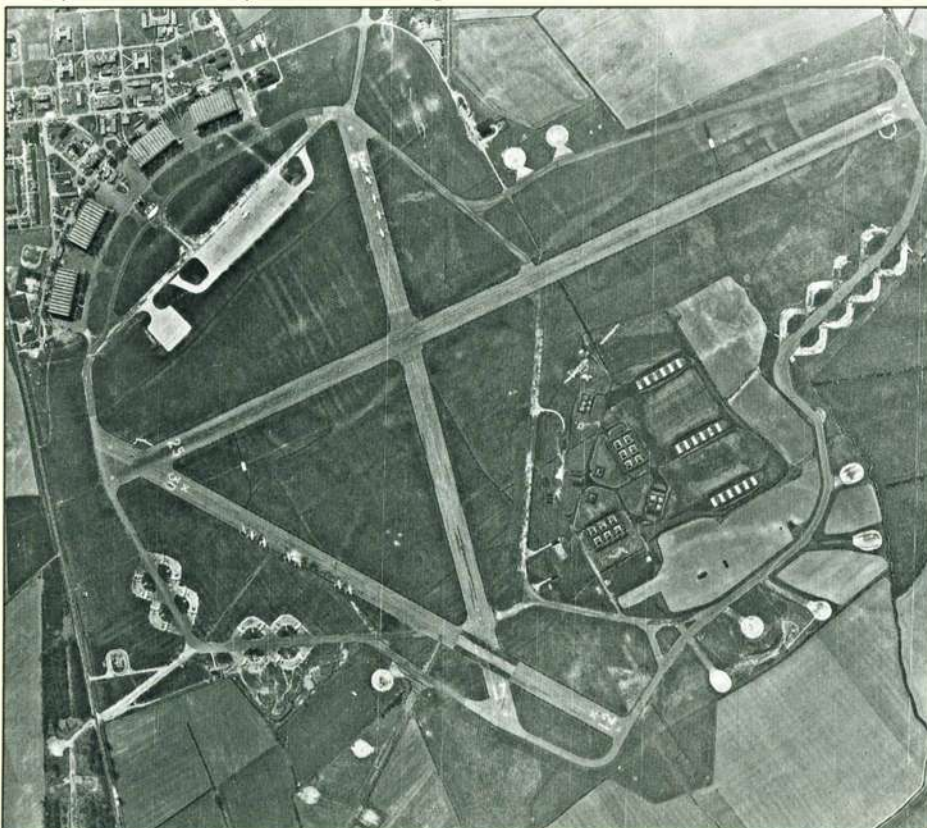
indication of looming airfield problems when snow and ice melted and aircraft grounds into seas of mud and dangerous ruts. Only five British aerodromes had hard surfaced runways before the war, partly due to the cost but also because of the difficulty of camouflaging them. By winter 1940 conditions — particularly at bomber and training stations — again brought problems, particularly at Oakington where the first Stirlings churned the surface into a quagmire and coke was rushed in to provide hard standings. Although the idea of metalled runways was not universally popular, by April 1941 they were being laid at 100 airfields then under construction, providing lasting tough surfaces. It was not just a question of laying concrete or tarmac runways as tracks were needed to lead aircraft to them from their hard dispersal pads. Three runways at each bomber station were decided upon, one of 1,400 yards and two 1,100 yards in length, and a familiar wartime pattern was born. To camouflage aerodromes mock hedges and roads were painted across them. No 4 Group painted some of its Whitleys all-black to disguise them on tarmac metalled areas, but reduced intruder activity rendered such ideas less important.

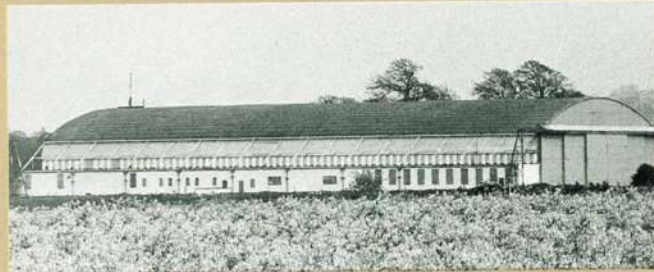
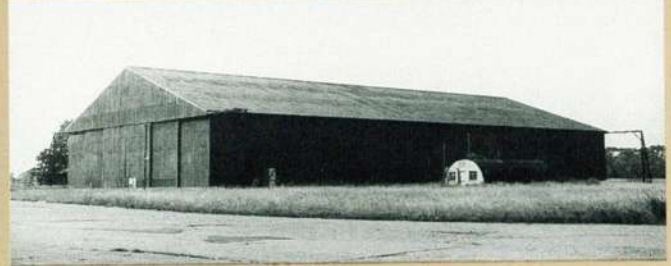
Rather than disrupt operations at main bomber bases, runways were first laid at new and satellite operational aerodromes whose shapes lent themselves more easily to modification. With runways laid many a satellite was soon uprated into a full self-accounting station, rapidly increasing the number of major airfields.

A 1937 idea had led to the Bellman range of pre-fabricated 87-foot wide metal hangars. Shelter needs for major maintenance programmes were now met with a 1940 type, the 113-foot wide, 240-foot long Tees-Side Bridge Co 'T2' (Transportable) metal hangar, extendable as required. The Ministry of Aircraft Production introduced its own mid-war version, the 'B1' Type. A large proportion of both types remain, mainly in civilian use.

Improved flying control towers also proliferated in 1941, answering the need to control great increases in activity. Living accommodation, mainly set in widely dispersed domestic sites, was often in semi-prefabricated or Nissen huts. Such items proliferated widely, and particularly at USAAF stations from where the term 'airfield' emerged to supercede the more elegant 'aerodrome'. Much use was also now being made of taxi areas, roads and runways of steel planking including the plentiful Somerfeld Tracking.

Aerial view at Bassingbourn in 1956 showing the hangar arc, prominent ASP and extended runway. Two closed runways offer hardstandings for Canberras.





AIRFIELD ARCHITECTURE

Left (top): One of Mildenhall's newly completed Type 'A' Aircraft Sheds. (Middle): A fine example of the Type 'C' hangar still in existence at Bircham Newton. (Left): Typical 'J' type hangar at Honeybourne, once a base for Whitleys of No 24 OCU.

Above (top): T2 hangars were found on many bomber stations — this one is at Wrating Common.

Above: A higher roof ridge and pylon door supports readily distinguish this B1 hangar from a T2.

Additional were the specialised airfields. Relief Landing Grounds — grass fields with a few huts — were used for 'circuits and bumps' flying. Emergency Landing Grounds, like Woodbridge, whose runways were three times the width and twice the normal length, provided refuge for battle-damaged aircraft. Among the many airfields opened in the south and east of England to support the 1944 Normandy invasion were temporary two-runway Advanced Landing Grounds. Add to all of these naval stations and civilian aerodromes serving war purposes and it is small wonder that around 1,000 airfields and seaplane stations existed by 1945.

The post-war wind down was effected by new developments — jet aircraft needed ample space, there was less need for multiple runways and population agitation over noise increased. While the elaborate permanent stations were mostly retained, strategic needs played a major part. A

need for good neighbours was also kept in mind when, for instance, Meteors were stationed at Bentwaters instead of Boxed near Colchester. Many wartime airfields became camps for recruits, displaced persons, stores, and also industrial training centres.

When the Cold War induced the return of American bombers, the USAF wanted them based on some of those original Midland bomber bases earmarked for the RAF's V-Bombers and still protected by the fighter belts. Those airfields, including Brize Norton and Fairford, not being ready, the USAF settled again in the east and shared many famous bomber stations with the RAF.

Soviet threats led to an enlarged RAF fighter force which was maintained until the V-Force came into existence. Each bomber and fighter airfield was provided with one well-lit long runway. To speed up

scrambles, twin runways were tried but their introduction would have been very costly. Instead, concrete Operational Readiness Platforms began to be laid in 1952, at either end of the runway, where fighters and V-Bombers stood plugged into a tele-scramble system awaiting the order to 'Scramble'. Peacetime servicing and turnaround took place on the Aircraft Servicing Platform. Fear of 'Rats' — low, fast-flying intruders — led to blast walls protecting dispersal pans at fighter airfields. They were the predecessors of today's Hardened Aircraft Shelters, standing close to NBG protected buildings in place of the 'soft' huts of yesteryear. All of this was a long, long way removed from the pilot running to his Bristol Bulldog to defend London. Those airfields I mentioned at the start of the article? In order, they were Feltwell, West Raynham, Debden, Caishot, Stradishall, Hornchurch, Mildenhall and Felixstowe.

A No 5 Squadron Lightning is re-armed on Coningsby's ASP. Behind is a Gaydon Type hangar for V-bombers.



STUDENT FLIERS

T. Malcolm English

University Air Squadrons (UASs) were introduced just after World War I at the instigation of Lord Trenchard, with the aims of encouraging an interest in flying and promoting and maintaining liaison with the universities in technical and research problems affecting aviation. The first squadron to form was Cambridge UAS, on 1 October 1925, with Oxford UAS becoming operational ten days later. Surprisingly, in spite of the UAS's popularity, it was not until 1940 that the Air Ministry founded Air Squadrons at 20 other universities and university colleges in Great Britain and Northern Ireland. At this time, the emphasis was to attract potential pilots for the Royal Air Force and to provide them with pre-entry training.

Today, there are 17 UASs throughout Britain which are affiliated to 56 Universities, University Colleges and Polytechnics, and the objectives have increased in scope. Whilst the UAS still wants to recruit high calibre undergraduates for the RAF, it is equally keen to promote air-mindedness and a sympathy for the RAF's philosophy, particularly in this country's future leaders, a large

percentage of whom will pass through the universities and polytechnics.

There are three types of UAS entrant: University Cadets, Bursars and Volunteer Reserve members (RAF(VR)). University Cadets and Bursars are sponsored by the RAF, having been accepted by the Officer and Aircrew Selection Centre at Biggin Hill. The University Cadets are commissioned as Acting Pilot Officers and are paid accordingly and after graduating they enter the RAF as junior officers. The Bursars are committed to the RAF for at least a Short Service Commission on graduation.

RAF sponsored students automatically become members of the UAS, including those destined for ground branch careers. Ground branch members can fly with the UAS always providing that he or she is medically fit. Indeed, in some respects these students benefit more from membership of the UAS than do future aircrew members. It is often the only formal flying training that engineer officers, air traffic controllers and fighter controllers will receive.

In contrast, RAF(VR) members have no commitment to the Royal Air Force at all.

Below: Echelon port formation of three Cambridge UAS Bulldog T1s, appropriately arranging the tail code letters to read UAS. T. Malcolm English



They are undergraduates who wish to learn to fly and to gain an understanding of the RAF. Applications for the UAS always exceed the numbers of vacancies, usually by a factor of four or five to one. The main attraction is undoubtedly the offer of free flying training.

Recruitment is traditionally carried out at the freshers fair; notices are also put up around universities and leaflets placed in all students' pigeon holes. Competition for the student's leisure time, however, is intense and in spite of all this advertising many students apply too late for

acceptance. They need to apply within their first week at university. As a result, many RAF(VR) members are second year students. It is hoped to alleviate this situation shortly when the UAS embarks on an advertising campaign with sixth formers, before they leave school.

Due to the widely spaced geographic locations of universities it is not possible to recruit RAF(VR) students at all of the universities in the country. Those without access to a UAS have, however, been kept to a minimum through careful planning. In Wales, for example, the problem has been solved by having one squadron based at St Athan, which is responsible for the Universities of Cardiff and Swansea as well as Bangor and Aberystwyth in the north. The latter are served by the aircraft

detaching to RAF Valley. Thus travel distances are overcome by taking the aeroplanes to the students.

Students applying for RAF(VR) membership have to pass a medical examination and an RAF Biggin Hill style interview before being accepted. The aim of the interview is to assess the applicant's motivation, character and initiative. Although it is not possible to test for flying aptitude, a measure of the effectiveness of the selection procedure is that it is most unusual for a student to 'drop out' of the UAS, through being unable to meet the flying demands of the Bulldog T1.

The total number of students under training varies throughout the year but on average there are 980. Of these, the majority are RAF(VR) members although the ratio varies considerably between squadrons. In 1985, for the first time in its history, the UAS allowed female



A student making a pre-flight check on a Southampton UAS Bulldog.
Andrew March



The Bulldog has a large clear canopy and a military feel.
Peter R. March





Prior to the Bulldog, DH Chipmunks equipped the UASs, this formation belonging to Southampton UAS. Nick Western



Main picture: Fitment of a VOR to the Bulldog fleet will be a useful aid to navigation above cloud and in poor weather conditions. Bulldog T1 of the Cambridge UAS. T. Malcolm English

undergraduates to join as flying members and they now comprise some 10% of the strength. Traditionally, women have not been recruited for combat roles. However, recognising the skills of female pilots in the UAS, Air Chief Marshal Sir Peter Harding, Chief of the Air Staff, has stated that the issue of women pilots in the RAF is currently being 'closely studied'.

All flying training is carried out on the Scottish Aviation Bulldog Series 130, of which there are 80 in service with the UASs. Maintenance of these Bulldog T1s is carried out by civilian contractors. There are two flying training courses, a two-year basic course of 20 hours flying per year and a main course, for more able students and all pilot University Cadets, comprising 33 hours per year for three years.

The Bulldog T1 was introduced into service with the UASs in 1974, becoming the 17th of a line of distinguished aircraft to operate with the squadrons. A side by side two-seat aircraft, powered by a 200hp Avco Lycoming engine, the Bulldog T1 is a very capable aircraft with a military feel. Typical of its suitability is the good all round visibility, afforded by a large bubble canopy. This and its +6g to -3g structural tolerance, are particularly valuable when performing aerobatics. Consistent with other Support Command aircraft, the Bulldog T1s are resplendent in red and white markings.

Although the Bulldog T1 has an excellent airframe, operations have been somewhat restricted by its lack of a comprehensive radio and avionics fit. This is now in the process of correction and a trials aircraft from A&AEE (Aeroplane and Armament Experimental Establishment) Boscombe Down is undergoing trials with new avionics and radio equipment. Bulldog T1 XX714 has been equipped with a height encoding transponder, ILS, VOR and a UHF/VHF radio.

With the increased dependence on radar services the transponder is a boon, allowing clear radar identification. The VOR is equally valuable in that it provides the ability to obtain a position fix in poor weather and above cloud. A further addition to the Bulldog T1 is a pair of high intensity strobe lights, one above and one below the fuselage. These are being fitted to a number of aircraft in service with the RAF in order to increase their visibility and hence reduce the risk of collision.

The training syllabus begins with basic handling, leading up to the first solo flight. This is followed by circuit work with many take-offs and landings, to consolidate the lessons the pilots have learned and to foster confidence. The students gradually progress to steep turns, simulated forced landings and aerobatics away from the airfield. When they are judged to be sufficiently competent, they are allowed to practise these exercises solo. After some 35-40 hours the students must pass a basic handling test which is, for most RAF(VR) officers, the highest standard they can reach whilst at university.

Students that show a particular aptitude for flying and pilot University Cadets are streamed onto the main course. This is to a generally higher standard and includes some instrument and navigation flying. By



A Bulldog of Birmingham UAS, which operates from RAF Cosford. Peter R. March

the end of their second year, students on the main course should have obtained the RAF Preliminary Flying Badge. One of the most demanding aspects of the main course is formation flying. Indeed, only those students awarded a third year of flying training are likely to achieve the standard required.

In addition to flying training, the UAS provides RAF(VR) members with the opportunity to be a member of an RAF squadron for two years. Indeed, if flying training were the sole aim of the UAS it would be more economical to contract the task to a civilian flying club. However, students would then lose their involvement with the small military unit to which they belong. Military discipline is taught and observed during flying training, at ground lectures and at summer camp. Students wear uniform, learn to salute and are taught the etiquette of the officers mess. Almost every UAS has a town headquarters which is used for training and is administered on the lines of an officers mess. Lectures are held weekly during term, the subjects of which may range from aviation medicine to how the Harrier works. The town headquarters is also used for the social functions arranged during term.

Each year, during the university summer vacation period, squadrons deploy to RAF stations for summer camp, including one UAS to RAF Germany. This gives students the opportunity of four weeks of concentrated flying and to gain an insight of life in the RAF. For further experience University Cadets visit an overseas base, such as Akrotiri, Ascension Island, Hong Kong, Germany or Belize for two weeks and RAF(VR) members have the opportunity of going to a UK station. Whilst there, University Cadets are attached to an officer of an appropriate branch; engineer, fighter controller, pilot or whatever and become their shadow. This is particularly useful for ground branch cadets as they do not get relevant experience on their UAS squadron. RAF(VR) members are given work to suit the station; typically, on a Harrier squadron the student might help to run the operations desk. All students adopt the life-style of a commissioned officer and effectively become part of the hosting unit for two weeks.

The commitment on students during term time amounts to one or two half days



New RAF (VR) students relax in the crewroom at Cambridge Airport. T. Malcolm English

per week for flying, plus preparation time, and one evening for ground studies. Examinations on aircraft systems, air law, navigation meteorology and principles of flight require little preparation, tuition being mainly by self-study text books and professional 'chat' in the officers mess.

Squadron Commanders are aware of the danger of over enthusiastic students spending too much time on UAS activities and ensure that the student's academic studies do not suffer as a result. In addition, the progress of all students who enter the UAS through Bursaries or Cadetships is monitored by Headquarters UAS, RAF Cranwell. At the first sign of a student's studies producing results below those expected, the UAS Squadron Commander and Headquarters will offer assistance.

As to the future of the UAS, the objectives are unlikely to change, nor is the tried and tested method of flying training. The Bulldog T1, good though it has been, cannot last forever. Its replacement is currently being debated by the Flying Training Staffs at HQ Support Command and in the Ministry of Defence, who will seek the advice of the UAS in due course. There are not even rumours about the Bulldog T1 replacement yet, but it is very unlikely to be the Shorts Tucano. Although a most capable elementary trainer, it is too sophisticated an aircraft for the level of training provided by the UAS.

The UAS's success in fostering an empathy with the RAF is very subjective but it is considered to be very high. The value in training sponsored students is more easily quantified. As an example, those Student pilots who are trained to the Preliminary

Flying Badge standard and have a basic instrument flying grading, require less flying time in the current Jet Provost during basic flying training at the Flying Training School or RAF College Cranwell.

Such is the difference in operating costs between the Jet Provost and Bulldog T1 that the resultant saving in flying time on the Jet Provost almost pays for the cost of UAS flying. It is also of note that some 40% of the fast jet front line aircrew started their service with a UAS.

Statistics and money, however, are dull colours with which to paint a picture of the spirit and commitment of the part-time student pilots of the University Air Squadrons. The inter-squadron aerobic competitions show that it is possible to reach a commendable standard of display flying in less than 100 hours and, together with frequent sporting meets, sharpen the friendly rivalry between neighbouring Universities.

It takes a lot of dedication to regularly give up your spare time and travel some distance for a weekend's flying. The instructor officers, too, put a lot into their units, taking on, in microcosm, all the myriad functions of a full size RAF station. Squadrons organise mountaineering, canoeing and sailing expeditions, raise money for charity and enjoy a lively social life. It is no surprise, therefore, that in many Universities and Polytechnics the Air Squadron is the most popular 'club' an undergraduate can join.

AIRCRAFT FLOWN BY UNIVERSITY AIR SQUADRONS

Avro 504K	1913 – 1932
Avro 504N	1920 – 1932
Bristol Fighter Mk III	1928 – 1932
Armstrong Whitworth Atlas Trainer	1931 – 1935
de Havilland Tiger Moth	1932 – 1951
Avro Tutor	1933 – 1939
Hawker Hart Trainer	1937 – 1939
Hawker Audax	1937 – 1939
Miles Magister	1938 – 1939
Hawker Hind	1938 – 1939
North American Harvard	1938 – 1955
de Havilland Chipmunk	1946 – 1975
Avro Anson T21	1948 – 1952
Percival Prentice T1	1948 – 1952
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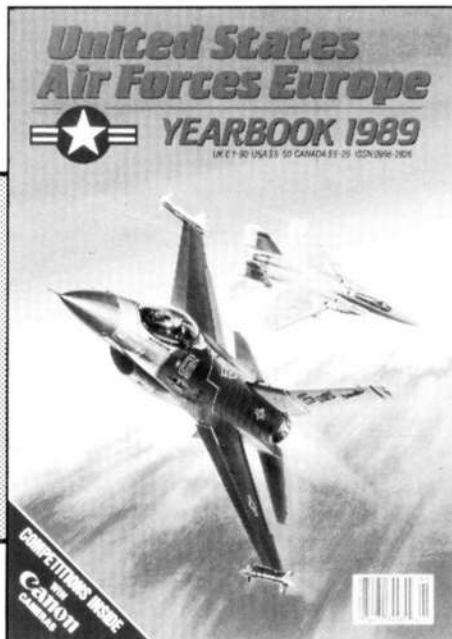


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Damaged aircraft repair and recovery, together with the training of personnel in the techniques of battle damage repair are little publicised tasks for units at RAF Abingdon.

Sue J. Bushell first takes a look at the

RSS

REPAIRERS TO THE ROYAL AIR FORCE

Some of the less glamorous but vital parts of Royal Air Force work are those duties performed by the Repair and Salvage Squadron (RSS), which is based at RAF Abingdon. The RSS is responsible for assessing damage to all fixed-wing service aircraft throughout the world, with the exception of mainland Northern Europe. This is dealt with by No 431 Maintenance Unit based at RAF Bruggen in West Germany. Although the number of personnel on strength is more than 240, only a few of the staff are present at Abingdon at any one time, with the bulk of unit members scattered around working at other RAF stations, only returning to their home base at weekends. This arduous lifestyle calls for dedication of the highest order.

The RSS is divided into two branches, of unequal size. The larger of these, with approximately two-thirds of the workforce, is itself split into two sections — Nos 1 and 2 Aircraft Repair Flights, and it is these two Flights which carry out the actual repair work. The RSS is responsible both for accident repairs, such as bird strike damage and undercarriage collapses, as well as repair work uncovered during routine servicing such as fatigue cracks. It also performs other work as and when required, like the current modification programme to the seat restraints on the RAF's Bulldog fleet.

The unit first assesses the damage to the aircraft, once it has been called in by the unit concerned. For this purpose the

RSS maintains a group of senior non-commissioned officers (SNCOs) who can be sent to survey the aircraft and accurately assess the category of damage into which it should be placed. Currently the RAF has five categories of damage — Categories 1 and 2 are both minor and the repair is within the capabilities of the parent station. Category 5 is scrap — the aircraft is beyond economic repair — while Category 4 is used when an aircraft needs to be returned to the manufacturer for repairs. Category 3 identifies a repair where special skills or equipment are required. This work will be performed by RSS or by a contractor's working party.

Once RSS has categorised the damage and its recommendations have been approved by Support Command Headquarters at Brampton, work can begin on repairing the aircraft. When the go-ahead has been received, RSS dispatches a surveyor to inspect the damage as closely as possible, dismantling the damaged section of the aircraft if necessary to gain an idea of the spare parts required to complete the repair. Once the surveyor has completed his task, the details for the repair scheme can be finalised.

At its Abingdon base, the RSS has many thousands of repair schemes on file, covering not only all fixed-wing RAF aircraft types but also those of the Fleet Air Arm and Army Air Corps. It does not handle helicopter repairs, these are left to the Fleet Air Arm, which has the necessary expertise and specialist facilities. Nearly

three-quarters of a million microfiche slides of aircraft drawings are also retained on file, from which hard copies of plans can be made. The RSS can also call on a specialist drawing office if drawings are not readily available, and this facility has recently been enhanced by the installation of a Computer Aided Design (CAD) system. It can also refer back to the aircraft's manufacturer if the work is particularly complex.

From these drawings and the notes made by the surveyor, the necessary replacement parts can be ordered or, quite regularly, fabricated by RAF Abingdon's workshops. This is quite often the case with repairs to older aircraft types where replacement parts are no longer held in stock by manufacturers. Once all these tasks have been completed and the parts have been acquired, a working party is formed to carry out the work involved in restoring the aircraft to flying condition. This is the task performed by the two Aircraft Repair Flights.

The 140-plus personnel are divided roughly equally between No 1 and 2 ARFs, and the country is also divided in half along the M1 motorway. No 1 ARF is responsible for repairs performed in the southern and western half England and the whole of Wales. No 2 ARF looks after the eastern side of England; Scotland is also divided, with No 2 ARF looking after Leuchars and No 1 ARF catering for the needs of Lossiemouth and Kinloss. All foreign trips are allocated on a strict turn and turn about basis.

Working parties vary in size, ranging from two to seven or eight as a rule, although this naturally depends on the scope and urgency of the job in hand and more personnel can be called in as required. Each task on RSS books is given a job number consisting of four numerals — the first being the year number (e.g. 1988 = 8) and the other three in strict numerical progression. This is followed by either one or two letters — A for accident, AB for other causes. Three classes of priority are allocated to denote the urgency of the task. Priority 1 covers all NATO front-line aircraft while Priority 2 concerns front-line non-NATO aircraft, and broadly speaking, Priority 3 covers the remaining aircraft.

The Repair and Salvage Squadron utilises part of a hangar at Abingdon for its 'home' work. Here, the unit is engaged in overhauling a Hercules Quick Engine Change Unit, which involves replacing the bulkhead and skins. Photographs Sue J. Bushell unless otherwise credited.



Once the repair team arrives on site, it must first complete the removal of damaged parts from the airframe, ready for the repair to be carried out. Only then is it able to start on the actual repair, following the worksheets which were raised by the surveyor after his inspection of the damaged aircraft. The working party receives regular visits from the surveyor to check that the repair is progressing according to plan and by quality inspectors to ensure that it is being performed to the standard required. Any additional problems which come to light during the course of the repair can also be resolved — these include instances where the original fasteners cannot be used because the original holes have become worn over time, so that larger fasteners are needed. Such a problem as this may seem trivial, but is all part of producing a first class repair. Once the RSS working party has completed its work, the repair is finally inspected and the aircraft returned to service.

New arrivals at the RSS undergo a six-week training course before they are assigned to work parties. They can then be sent out to other airfields, under the guidance of a team leader, to gain valuable experience in the field. The team leaders themselves undergo a one-week training course, also held at Abingdon, while the arrival of composite materials such as those used in the construction of the Harrier GR5 has necessitated another course of two weeks duration to provide training in these new materials.

Although most of its tasks are performed away from Abingdon, RSS also handles some work at its home base. One of these recently has been a repair to the Hercules Quick Engine Change Unit. RSS replaced the bulkhead and skins immediately aft on the engine. It is also responsible for looking after the Royal Air Force Exhibition Flight's collection of aircraft — both 'real' and fibreglass replicas — and nose sections, which are housed at Abingdon.

The Exhibition Flight is one of the most public sections of the RAF, visiting many airfields and towns throughout the summer months. Its collection of aircraft naturally has to be moved by road, and this task is performed by the Aircraft Salvage and Transportation Flight, which employs the remaining third of the RSS personnel. The AS&TF is responsible for positioning airframes where required, be it in the centre of Earls Court for the Royal Tournament or at an RAF Open Day or Town Show in Scotland. However this is not its only function.

Whenever an RAF aircraft crashes or makes a forced landing, it is the AS&TF which must retrieve it and remove it to another site, either its home airfield or, in some cases, the Air Accident Investigation Branch compound at Farnborough. This work is not confined to removing RAF aircraft, however, and the Flight is also called to assist in the recovery of crashed civil aircraft. Unfortunately, this is seldom a very pleasant task, as it can involve the recovery of many small pieces of wreckage from some of the most inhospitable countryside in the UK. Most recently, members of the RSS were dispatched to



Above: One of the RAFF's two Spitfire LF16s gets a winter overhaul. In the foreground of the photograph is the Royal dias and its packing case. The RSS is also responsible for transporting and assembling this item wherever it is needed.

Below: Another repair being undertaken at Abingdon, this time on a Sea Harrier wing section. The RSS is responsible for all fixed-wing service aircraft repairs throughout the world, with the sole exception of mainland Europe.



Lockerbie to assist in the recovery of wreckage from the Pan American Boeing 747 crash shortly before Christmas 1988. Three weeks later, they were collecting together the pieces of the British Midland Boeing 737 from the M1 motorway. Another task on its doorstep concerned the Phantom from No 228 OCU which crashed at Abingdon whilst practising for the 1988 Battle of Britain At Home Day there.

The AS&TF are specialists at recovering aircraft from unusual sites, such as farmer's fields, hillsides, woods and other exceptional terrain. They are skilled in getting large trailers through small gates, and in causing as little additional damage as possible to land — skills which are also put to use when driving through narrow town streets with a Spitfire or full-scale fibreglass Tornado replica on a trailer.

The duties performed by all branches of the RSS are exacting and require a substantial amount of unsupervised work, calling for considerable effort and initiative. Members of the RSS can spend up to nine months of the year away from home during the week, although the work is rewarding and extremely variable — the types covered ranging from the Spitfires, Hurricanes and Lancaster of the Battle of Britain Memorial Flight to the new Tornado F3 and Harrier GR5, both of which are just embarking on their front-line service careers and can be expected to provide the RSS with work for many years to come. RSS's flexibility means that it can cope with a wide range of repairs at any one time, and in the year 1987/88 it handled more than 200 tasks on no fewer than 23 different aircraft types. At the RSS, variety is the very essence of its existence.

The work of the RSS was dramatically brought to public notice shortly before Christmas 1988, when the unit despatched a large team to Lockerbie to assist in the search for wreckage from the Pan Am Boeing 747. The bleak moorland was combed for pieces of all sizes. Here, two members of the RSS discuss the retrieval of a large section of wreckage. Three weeks later, the RSS was again in action, this time at the scene of the Boeing 737 crash on the M1 motorway near East Midlands Airport. RSS



BDR BATTLE DAMAGE REPAIR

Many RAF airfields in the United Kingdom maintain at least one aircraft which is designated for Battle Damage Repair (BDR) training duties. They are often aircraft retired from service, such as the Hunter, Lightning or Canberra, although more modern types can be found. The aircraft serve to fulfil an important function in preparing tradesmen to repair aircraft during times of conflict, a task that will hopefully never be put to use.

Battle Damage Repair involves, as its title suggests, the repair of damage inflicted under combat conditions and it is a skill at which the RAF leads the world. The BDR School is based at RAF Abingdon, and it is to Oxfordshire that students come to be trained in the techniques of rapid repair in hostile situations. The students come from the British armed forces, every NATO member and many forces worldwide. The methods developed at Abingdon have been adopted throughout the western world.

Students are selected from various RAF stations and detached to Abingdon for courses, where they learn various non-standard techniques that would only be used in wartime. Unlike the Repair and Salvage Squadron, whose repairs must be to full service standard, those used in battle damage repair are by their very nature temporary and are aimed at making full strength repairs as quickly as possible. Emphasis is placed on using initiative and innovation in adapting the techniques rather than going 'by the book'. The major requirement is that an aircraft can return to fight again without delay. If a damaged aircraft is able to land safely, the chances are that most of the damage will be repairable within reasonable time-scales. It should be stressed, however, that the BDR techniques are for use in wartime only and does not for instance deal with one-flight repairs to enable an aircraft to return to its parent station under its own power in peacetime.

Once the students have been trained to the satisfaction of the eight-man staff of the BDR School, they return to their home stations. BDR teams are present on most



Above top: A major problem facing personnel engaged in Battle Damage Repair work is the lack of modern aircraft on which to practise techniques. This Canberra rear fuselage section is being used as a suitable subject for panel and rib repair. Photographs Sue J. Bushell.

Above: Buccaneer XT284 has been in use with the BDR School at Abingdon for some time and is pock-marked with shell holes. Pencil lines under the serial number highlight internal ribs to be repaired.

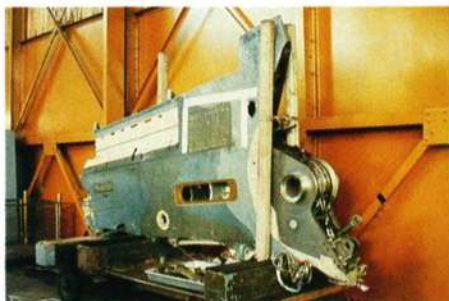
RAF operational airfields, ready to deal with potential casualties in time of war. Special BDR tool kits are issued, with between two and four being allocated to each station, depending on the role of the resident units during wartime. To allow practice of the techniques, the BDR teams often have their own redundant airframes on site. Although usually of 1960s vintage some current types such as the Tornado and Harrier are occasionally available. BDR is also an important part of a Tactical Evaluation (TACEVAL), when Abingdon will task the teams with practice repairs under simulated wartime conditions.

The lack of modern airframes on which to practise techniques is a problem for

Flight Lieutenant David Helliwell, who commands the BDR School. He has at his disposal a compound of life-expired aircraft that have been withdrawn from service. Unfortunately, not all types are suitable for BDR duties which by its very task requires up-to-date machinery on which to rehearse techniques. For instance, the Canberra, of which two are present at Abingdon, was introduced into RAF service nearly 40 years ago and, compared to the modern hardware of the late 1980s, is to say the least somewhat dated. Although some repairs to the airframe can be practised, it is impossible to use the Canberra for wiring techniques, as it bears so little similarity to modern aircraft. Further problems are going to crop up as carbon fibre composites increasingly make their presence felt in the next few years.

As aircraft are not supplied to the BDR School in a damaged condition, representative damage is created on site with the aid of shells similar to those that would be encountered in wartime. The aircraft is moved to a safe area and the shells are placed inside the fuselage, and then detonated. Considerable skill is needed to place the shells in places where they will do 'useful' damage similar to that found in combat situations. This damage is then repaired. As well as complete airframes, the BDR School has large chunks of crashed machines on charge, such as a wing section from a Tornado. This piece is large enough to enable difficult repairs to complex metal shapes to be attempted.

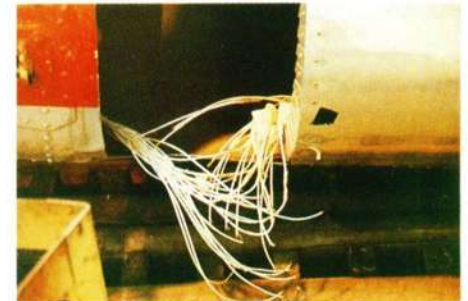
Since the School's formation in the late 1970s, the art of Battle Damage Repair has improved greatly. The first, and so far only, real test of its skills came with the Falklands War in 1982, in which the techniques then employed were used to great effect. Following the conflict and learning from the real time lessons, there has been a big improvement in the technology employed in BDR work. The repair capability of the RAF continues to advance as the RAF moves on towards the 21st century.



This Tornado wing, salvaged from a crash site, will make a good subject for BDR techniques. The inherent strength of titanium is evident on the wing swivel point, where a circular saw has made very little impression.



Shell damage to a Buccaneer undercarriage bay. This damage was inflicted at RAF Abingdon to provide a realistic repair scenario. Fragments of the shell travel a long way inside the aircraft, and all damage will have to be made good.



A rat's nest of wiring – the ends would have to be joined correctly before the aircraft could fly again. The wiring on most front-line aircraft types is marked at regular intervals, simplifying the task somewhat.



The RAF's Year 1988

Brian Strickland reviews some of the RAF's highlights of 1988.

JANUARY

A and B Squadrons of the **Aeroplane and Armament Experimental Establishment** at Boscombe Down amalgamated to form the Fixed Wing Test Squadron with three Flights. At the same time D Squadron was renamed the Rotary Wing Test Squadron. The new titles of A, B & C Flights have been resurrected from 1917 when the unit was at Martlesham Heath.



A Buccaneer S2 of the A&AEE's Fixed Wing Test Squadron. Daniel March

During a parade at Leuchars, **No 111(F) Squadron** received the Dacre and Skyflash trophies. The Dacre trophy has been awarded annually since 1951 for regular fighter squadron efficiency. The Skyflash Trophy, awarded since 1981, is competed for by all groundcrew of No 11 Group Phantom and Tornado F3 squadrons and is awarded to the team who carry out the fastest operational turnaround in full NBC Kit, whilst observing all safety criteria.

Following an emergency call, to help save a soldier suffering from kidney failure, a **Tristar of No 216 Squadron** set a new record for the fastest flying time of 14 hours 52 mins for the 8,000 mile journey from Britain to the Falklands.

The fastest *non-stop* flight between Britain and the Falklands was achieved by a **No 10 Squadron VC10 C1**, which took 15 $\frac{3}{4}$ hours, refuelling twice from a No 101 Squadron VC10 K3 tanker. The return journey took a little under 15 hours.

On 13 January the Queen Mother presented a new Standard to **No 617 Squadron** at Marham, the second time that she has bestowed this honour on the *Dambusters* squadron. The original standard was presented in 1959.

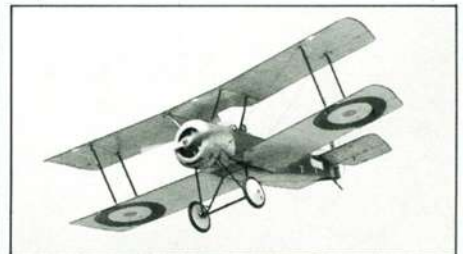
Wing Commander Kit Smith, RAF Leeming's Station Commander, officially opened the station's new runway on 11 January when he arrived in a Tornado F3 to begin Leeming's build up into its new role as an air defence base housing three Tornado Squadrons.

Cadet Sergeant Elizabeth Negandhi of No 6 AEF at Abingdon became the first female Flight Staff Cadet to be accepted for a commission in the RAF as a fighter controller.

Heading photograph: **RAF VC10 K3 of No 101 Squadron, Brize Norton refuelling a pair of Tornado GR1s of No 617 Squadron, Marham.** W.V. Palmer.

The last **Red Top** missile to be fired on a Missile Practice Camp, was discharged from **Lightning XR754** flown by Flt Lt Richard Heath, over Cardigan Bay.

18 January was the 100th birthday of pioneer aviator **Sir Thomas Sopwith**. A fly-past over his home included a quartet of RAF Hurricane, Hunter, Harrier and Hawk, as well as a Sopwith Pup.



A Sopwith Pup was flown to mark Sir Thomas Sopwith's centenary. Peter R. March

FEBRUARY

Ferranti Defence Systems Ltd was awarded a £3m MOD contract for a follow on supply of automatic test equipment to the RAF, with the increased number of Tornados in service.

On 13 February nine members of the RAF were among 36 mountaineers from the four armed services who set out to climb **Mount Everest** by a route never before successfully tackled by a British team.

It was announced that **Air Chief Marshal Sir David Craig** was to become the next Chief of Defence Staff in the rank of Marshal of the Royal Air Force. His successor, Air Chief Marshal Sir Peter Harding was previously AOC-in-C Strike Command. The new appointments became effective on 14 November 1988.

For the first time in the history of the competition, the RAF was victorious in the **Inter Service Ski Team Championship**, held at Méribel in France.

It was announced that the proposed take-over of the **Search and Rescue Service** by civilian contractors had been rejected. The Minister for the Armed Forces stated that whenever there was a military requirement for SAR it would continue to be provided by the RAF and RN.

The RAF took its first **Air Combat Simulator** on charge. Designed and built by British Aerospace, it enables fighter crews at Coningsby to train and practice air-to-air combat on the ground.

The MOD concluded a long lease with Kent International Airport enabling **Manston** to continue as an operational RAF airfield.

RAE Farnborough said goodbye to the **Westland Wessex**, its departure ending a 30-year utilisation of the helicopter for trials work.



One of the former RAE Farnborough Wessex.
Graham Finch

MARCH

Phantom XV582, which was one of the original airframes to enter RAF service on 9 May 1969, set a double record. Piloted by **Wing Commander John Brady**, OC of No 43 Squadron at Leuchars, it became the first Phantom to accumulate 5,000 flying hours in RAF service and also set up a new speed record by covering the length of Great Britain in 46min 44sec at a speed of 760 mph.

In response to the Prime Minister's stated wish for greater co-operation between British and French Forces **No 101 Squadron** detached a VC10 tanker to Mont-de-Marsan, in south-west France. In the course of an intensive flying programme the tanker made 71 refuelling contacts at both high and low level, with a Mirage F1, Mirage 2000, Jaguar and French Navy Etendard.

Jet Provost T3A XN501 was retired from active flying service at Scampton, the first retirement in anticipation of replacement by the Tucano T1. It was taken out of service after flying 8,480 hours in 28 years and went to Cosford for ground training.

APRIL

The Central Band of the RAF embarked on a tour of Japan, during which time they gave concerts at several major musical venues as well as featuring on Japanese TV and radio.

RAF Manston reached the target of £104,483 necessary for the extension of its Spitfire Memorial Museum.

The 50th major Tornado service was completed at **RAF St Athan**, shortly before the 50th and last for the Victor tanker. No 3 Squadron said goodbye to XZ996, the last of 46 Harrier GR3s to receive Major and Phase 6 servicing there. It is now concentrating on two-seat Harriers and the Fleet Air Arm's Sea Harriers.



RAF St Athan completed major servicing on its 50th Tornado. RAF St Athan

Hurricane LF751, now painted as BN230 of No 43 Squadron, which was for 30 years on display at HQ 11 Group, Bentley Priory, returned to the RAF on 22 April after restoration by the Aircraft Preservation Group of the Medway Branch of the RAeS.

30 April saw the official retirement of the **Lightning** (which first joined No 74 Squadron in July 1960) from the UK air defence role, when No 11 Squadron laid up its colour pending its reformation as a Tornado F3 squadron at Leeming on 1 July 1988.

MAY

On 1 May the Royal Aircraft Establishment was retitled the **Royal Aerospace Establishment**. The RAE came into being in 1918, having previously been known as the Royal Aircraft Factory since 1912.

The Parliamentary Under Secretary of State for Defence Procurement, announced an order for a further 34 **Harrier GR5s** for the RAF, bringing the total on order to 96.

Sir David Craig, Chief of the Air Staff, said that future pilot training was to be accomplished more quickly. The aim was to get a pilot from entry to the service into a front-line cockpit in 5% less time in financial year 88/89, with a further 5% reduction the following year.

On 5 May RAF St Athan returned one of the world's first rocket powered fighters to its former owner. **Messerschmitt Me 163 Komet 191904** was handed over to the new Aviation Heritage Centre being formed at Oldenburg, West Germany.

On 16 May some 50,000 people gathered at the Derwent and Ladybower Dams in the Peak District, to mark the 45th anniversary of the **Dambusters** raids which took place in 1943 on dams in the Ruhr Valley. BBMF **Lancaster PA474** was the anniversary attraction when it flew over the locations where No 617 Squadron practised for six weeks prior to the raid.



Lancaster PA474 marked the anniversary of the Dambusters raids. P.J. Richardson

JUNE

The RAF announced a new policy to further the preservation of its historic aircraft. **Spitfire gate guardians** were to be removed and some to be replaced by glassfibre replicas. Half of the original aircraft have been sold and will be restored to flying condition. In 1988 the RAF had over 100 aircraft as gate guardians. This number is to be reduced.

Two **Nimrod** crews from **No 206 Squadron** at Kinloss conducted a 14-hour low-level operation at the North Pole. Two refuelling contacts were provided by VC10s of No 101 Squadron. The mission was to provide support to two RN nuclear powered hunter submarines which had surfaced at the Pole.

RAF Akrotiri received a new gate guardian, a Lightning F6 which flew direct from Binbrook to Cyprus in 5¼ hours, requiring ten air-to-air refuelling contacts. The aircraft is to be displayed in natural metal finish, with the markings of No 56 Squadron, the air defence unit which was based in Cyprus.

On 7 June the Duke of Gloucester visited Brampton to open the new HQ building of **RAF Support Command**. The former HQ was destroyed by a fire in October 1985.

RAF Kinloss hosted the annual Aird-Whyte Trophy competition, which is competed for by Nimrod crews from the RAF's five operational maritime units. This year's winner was from No 201 Squadron.

No 115 Squadron based at RAF Benson, celebrated its 70th anniversary with a parade when Air Vice Marshal Ashford was the reviewing officer.

Lightning F6 XS903 was flown into the Yorkshire Air Museum at Elvington, near York. On 30 June the last flight was made by **RAF Lightnings** when XS898 and XS923 were flown from RAF Binbrook to a private owner at Cranfield.



Now at Cranfield, these ex-RAF Lightnings are privately owned. Peter R. March

The **5,000th Jindivik** sortie was flown from RAE Llandebr in North Wales, a milestone in the operation of this drone aircraft, which is a joint UK/Australian project dating back to 1948.

JULY

A flypast by four Tornado F3s from **No 11 Squadron** marked the transformation of **RAF Leeming** to a front-line fighter station following a £142m rebuilding programme.

The Duke of Edinburgh visited RAF Kinloss to present a new Standard to **No 120 Squadron**, one of Kinloss's three Nimrod units.

One of the most concentrated search and rescue operations involving the RAF was launched on the night of the world's worst oil rig disasters when the **Piper Alpha** platform exploded in the North Sea.

On 19 July, for the second time in less than 12 months, an RAF Station played host to the Russians. An Ilyushin 62 with 20 Soviet inspectors on board landed at **RAF Greenham Common**, when the first inspection of cruise missile sites in the UK took place under the INF treaty.

AUGUST

On 1 August **Air Chief Marshal Sir Thomas Kennedy** became Controller of the RAF Benevolent Fund in succession to Air Chief Marshal Sir Alasdair Steedman.

8-8-88, reputed to be the luckiest date in the calendar, was celebrated in style by **No 8 Squadron** at RAF Lossiemouth. The unit flew a four aircraft formation of Shackletons for the first time since 1973.

Four Wessex of **No 28(AC) Squadron** based at Sek Kong in Hong Kong saved the lives of several villagers who were threatened by rapidly rising flood waters following a devastating typhoon.

On 30 August two **Tornado F3s** from **No 5 Squadron** at Coningsby escorted a pair of Mig-29 **Fulcrum** fighters through UK airspace to Farnborough, where the Russian aircraft became the first Soviet front-line fighters to participate in the International Air Show. The rendezvous took place half-way across the North Sea and the four aircraft flew in formation for over 200 miles.



A Russian Mig-29 Fulcrum over Farnborough. Peter R. March

On 11 August a **Nimrod** of **No 201 Squadron** from RAF Kinloss was scrambled to assist a Cessna some 400 miles off course through a navigational error and running short of fuel between Greenland and Iceland. The Nimrod guided the Cessna through cloud to ditch alongside Weather Station Lima.

Four Tornado F3s from **No 29 Squadron**, together with air-to-air refuelling and transport support from two No 216 Squadron Tristars and a Hercules left the UK on 21 August to visit the Far East, Australia and the USA for a global deployment — **Exercise Golden Eagle**.

SEPTEMBER

On 9 September **Air Chief Marshal Sir Patrick Hine** succeeded Air Chief Marshal Sir Peter Harding as Air Officer Commanding-in-Chief, Strike Command.

The first **Shorts Tucano** was officially handed over on 1 September to the **Central Flying School** at RAF Scampton heralding a new approach to flying training in the UK. 130 of the type are on order.



Shorts Tucano T1 commenced service with the CFS. Peter R. March

The Strike Attack Operational Evaluation Unit (SAOEU) at Boscombe Down received the first of three **Harrier GR5s**.



Harrier GR5s in company with a pair of Tornado GR1s and a Harrier T4A of the SAOEU. MoD (PE) A & AEE

Flight Lieutenant Vryan Pappin, a physical education officer from Wattisham, won a Gold Medal at the **Seoul Olympics** as a member of the successful British hockey team.

On 19 September the **Red Arrows** performed its first display in Spain, at the Spanish Air Force Academy, Zaragoza, as part of the Spanish AF celebration for the 75th anniversary of military aviation in Spain.

A **No 78 Squadron** Sea King from RAF Mount Pleasant was involved in a challenging SAR operation when it flew a total of 8 hours to take a seriously ill Russian sailor from a Soviet factory ship pitching in heavy seas to hospital in the Falkland Islands.

OCTOBER

The Prime Minister presented a new Standard to **No 10 Squadron**, RAF Brize Norton which regularly flies VIPs around the world in its VC10s. Since 1979, Mrs Thatcher had flown 64 times with the Squadron, totalling 810 hours and covering 406,861 miles.

The largest number of Tornados at one location in Europe gathered at RAF Cottesmore for the third annual **Tornado Symposium** on 13/14 October. Some 50 RAF, German and Italian aircraft and nearly 200 aircrew and staff officers were present.



The impressive line-up of Tornados for the symposium at Cottesmore. Peter R. March

The **Adour** jet engine, which powers the RAF's Jaguar, logged its three millionth flying hour on 19 October. The Jaguar made its maiden flight in September 1968.

The first RAF crew qualified for operations with the **Boeing E-3A Sentry** aircraft of the NATO AEW Force at Geilenkirchen in Germany. Most of them have had several years of experience on the Shackleton and Nimrod. Eventually they will play an important role in setting up the RAF's own AWACS training centre at RAF Waddington in 1991.

The Under Secretary of State for the Armed Forces announced on 12 October that the **Officer and Aircrew Selection Centre** (OASC) was to move from Biggin Hill to RAF Cranwell by 1992.

The four **Exercise Golden Eagle** Tornado F3s completed 420 flying hours, and with their supporting Tristar ZD951, returned to RAF Coningsby on 26 October.

For only the third time in its 28 year history the **Queens Colour Squadron** provided the guard at Windsor Castle, from 16 October to 6 November.

NOVEMBER

Wing Commander Peter Day, OC of No 233 Operational Conversion Unit at RAF Wittering became the first pilot to achieve 3,000 hours on the **Harrier**, his total being reached in flying a GR5.

The Government announced an order for a further 26 **Tornado GR1s** and 15 **Tornado F3s** to sustain the RAF's Tornado force into the next century.

Improved coverage by Britain's **Search and Rescue Services** was announced. Eight RAF/RN Sea King and four RAF Wessex Flights, supplemented by three Coastguard Westland S61s (funded by the Department of Transport) are now available. A new Sea King Flight has been established at RAF Leconfield.



Sea King HAR3 of No 202 Squadron, a major provider of search and rescue services.

A statue of **Air Chief Marshal Lord Dowding**, who was Air Officer Commanding-in-Chief, Fighter Command in 1940, was unveiled by the Queen Mother at the Central Church of the RAF St Clements Danes. The occasion was also marked by the flight of a BBMF Spitfire over the church.

DECEMBER

The **Turbo-Union RB199** turbofan, which powers the Tornado (and the EAP demonstrator), achieved one million hours in service. It powers Tornados with 30 squadrons in Britain, Germany, Italy and Saudi Arabia.

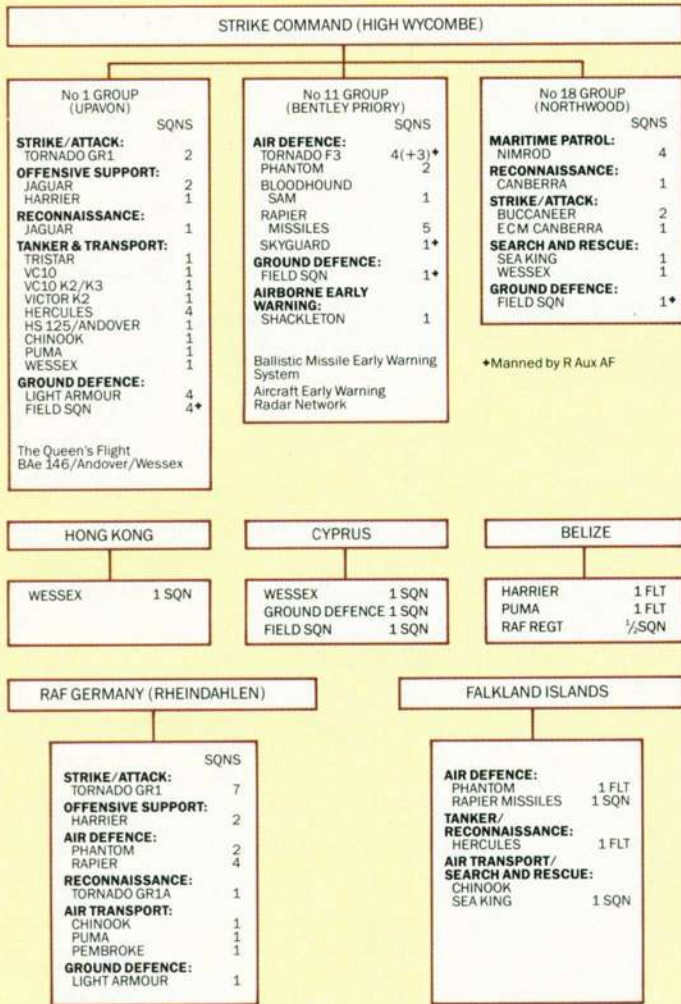
The RAF Fire School moved from Catterick to Manston and from the end of the month was known as the **RAF Fire Service Central Training Establishment** (RAF FSCTE), thus providing a single training school for all RAF service and civilian firefighters.

The last operational sortie by a Jaguar in Germany, was flown on 16 December, bringing to an end the 13 years of continuous Jaguar operations by the RAF in Germany. The last Jaguar belonged to **No 11(AC) Squadron**, which is the oldest flying squadron in the RAF. It was reformed on 1 January 1989 as the first Tornado GR1A reconnaissance squadron.



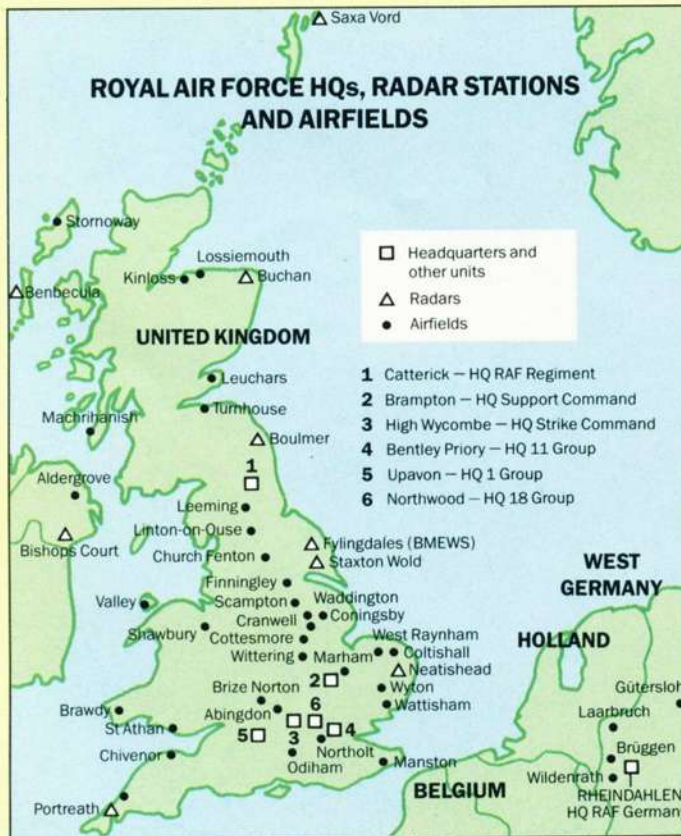
The Jaguar GR1 was flown for the last time operationally by No 11(AC) Squadron on 16 December. Peter R. March

OPERATIONAL SQUADRONS OF THE ROYAL AIR FORCE 1989



OPERATIONAL FLYING SQUADRONS

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



OPERATIONAL FLIGHTS

FLT/COMMAND	AIRCRAFT TYPE	OPERATING BASE
1312 Flt (Str/Fl)	Lockheed Hercules C1K	Mount Pleasant, Falklands
1417 Flt (Str/Dir)	BAe Harrier GR3	Belize City Airport
1435 Flt (Str/Fl)	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.

RAF REGIMENT SQUADRONS

SQN/COMMAND	EQUIPMENT	BASE (DEPLOYMENT)
1 Sqn (RAFG)	Spartan, Scorpion, Sultan, Samson	Laarbruch
2 Sqn (Str/1 Grp)	Spartan, Scorpion, Sultan, Samson	Hullavington (Gütersloh)
15 Sqn (Str/1 Grp)	Spartan, Scorpion, Sultan, Samson	Hullavington (Wildenrath)
16 Sqn (RAFG)	Rapier	Wildenrath
19 Sqn (Str/11 Grp)	Rapier	Brize Norton (Upper Heyford, Fairford)
20 Sqn (Str/11 Grp)	Rapier	Honington (Alconbury, Woodbridge, Bentwaters)
26 Sqn (RAFG)	Rapier	Laarbruch
27 Sqn (Str/11 Grp)	Rapier	Leuchars
34 Sqn (Str/Cyprus)	Spartan, Scorpion, Sultan, Samson	Akrotiri (RAFG)
37 Sqn (RAFG)	Rapier	Brüggen
48 Sqn (Str/11 Grp)	Rapier	Lossiemouth
51 Sqn (Str/1 Grp)	Spartan, Scorpion, Sultan, Samson	Catterick (Brüggen)
58 Sqn (Str/1 Grp)	Spartan, Scorpion, Sultan, Samson	Catterick (Laarbruch)
63 Sqn (RAFG)	Rapier	Gütersloh
66 Sqn (Str/11 Grp)	Rapier	West Raynham (Mildenhall, Lakenheath)
QCS (Str/Direct)	LandRover	Uxbridge (RAFG HSF)

RAuxAF REGIMENT SQUADRONS

SQUADRON	COMMAND	EQUIPMENT	BASE
2503 County of Lincoln Sqn (Str/1 Grp)		LandRover	Scampton
2620 County of Norfolk Sqn (Str/1 Grp)		LandRover	Marham
2622 Highland Sqn (Str/11 Grp)		LandRover	Lossiemouth
2623 East Anglian Sqn (Str/1 Grp)		LandRover	Honington
2624 County of Oxford Sqn (Str/1 Grp)		LandRover	Brize Norton
2625 County of Cornwall Sqn (Str/18 Grp)		LandRover	St Mawgan
2729 City of Lincoln Sqn (Str/11 Grp)		Oerlikon 35mm/ Skyguard	Waddington

Notes:

- Units equipped with BAe Rapier surface-to-air missiles are designated LLAD (Low-Level Air Defence) Squadrons.
- Units equipped with 15 FV103 Spartan armoured personnel carriers, six FV101 Scorpion armed reconnaissance vehicles, one FV105 Sultan command vehicle and one FV106 Samson recovery vehicle are designated LA (Light Armoured) Squadrons.
- Units equipped with LandRovers also possess LAW80 anti-tank weapons, machine-guns and personal weapons.
- QCS is the Queen's Colour Squadron which deploys to RAF Germany Helicopter Support Force.

Abbreviations used in the tables above: Str — RAF Strike Command; Grp — Group; RAFG — RAF Germany; FI — Falkland Islands; OCU — Operational Conversion Unit; TWCU — Tornado Weapons Conversion Unit; TWU — Tactical Weapons Unit; RAuxAF — Royal Auxiliary Air Force.



Shackleton AEW2 WR965 of No 8 Squadron, still operational in March 1989. Allan Burney

RAF Regiment Oerlikon 35mm cannon and a Tornado F3, part of the air defence team. Paul Jackson





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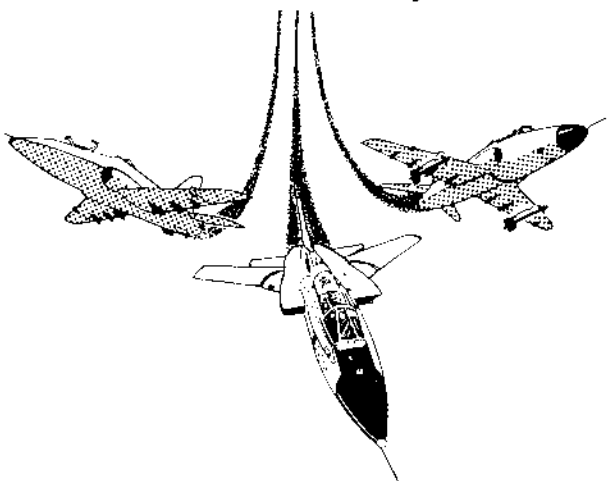
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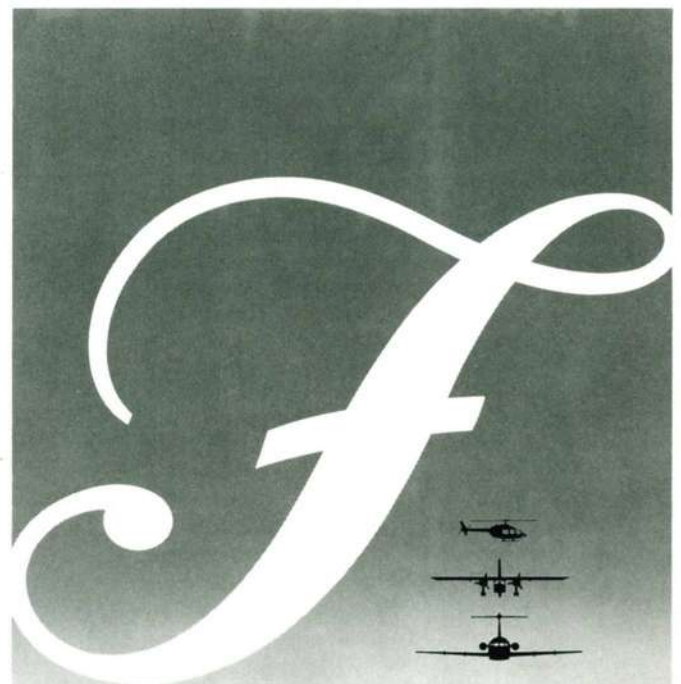
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