ROYAL AIR FORCE YEARBOOK 1976

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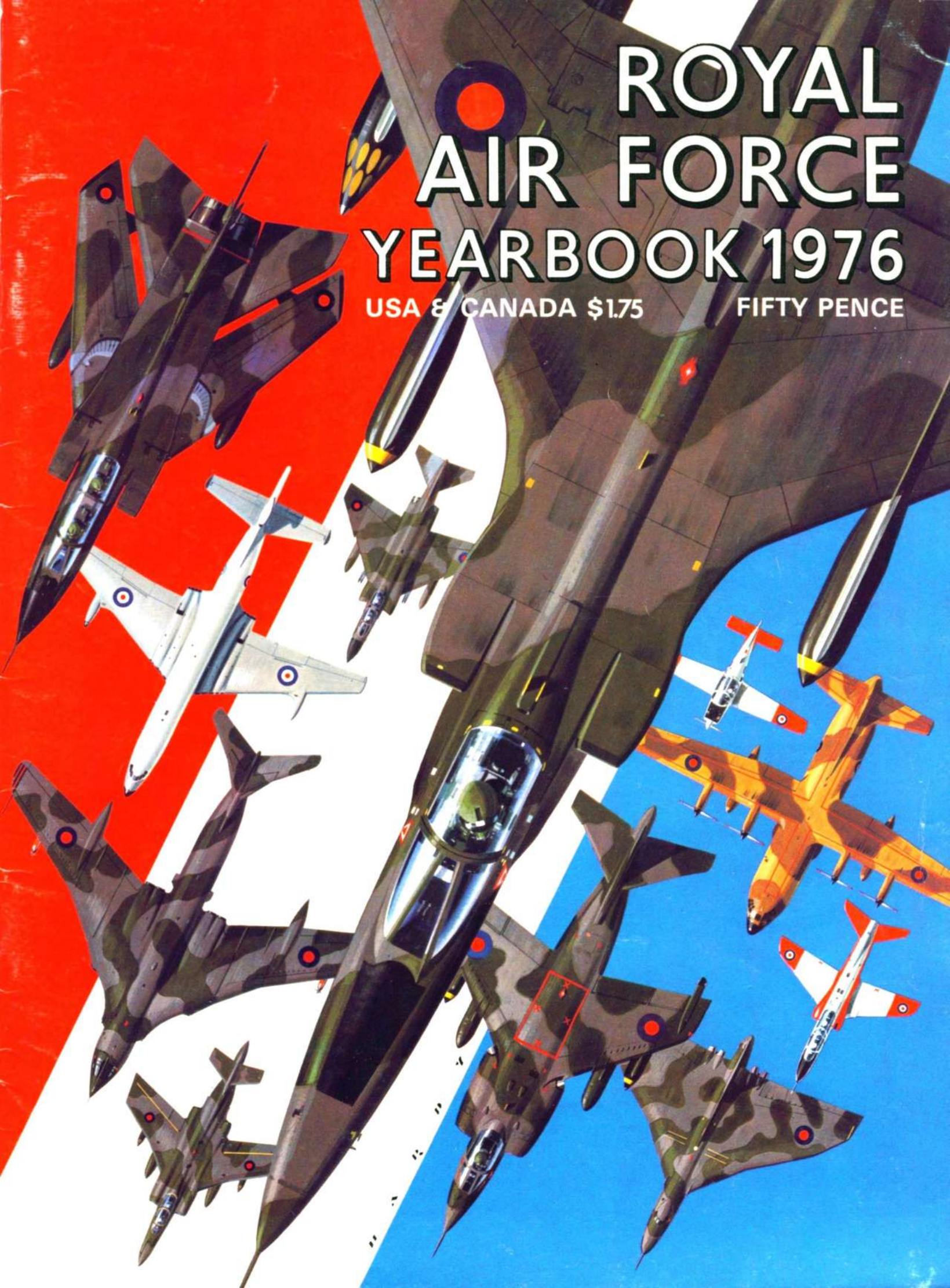

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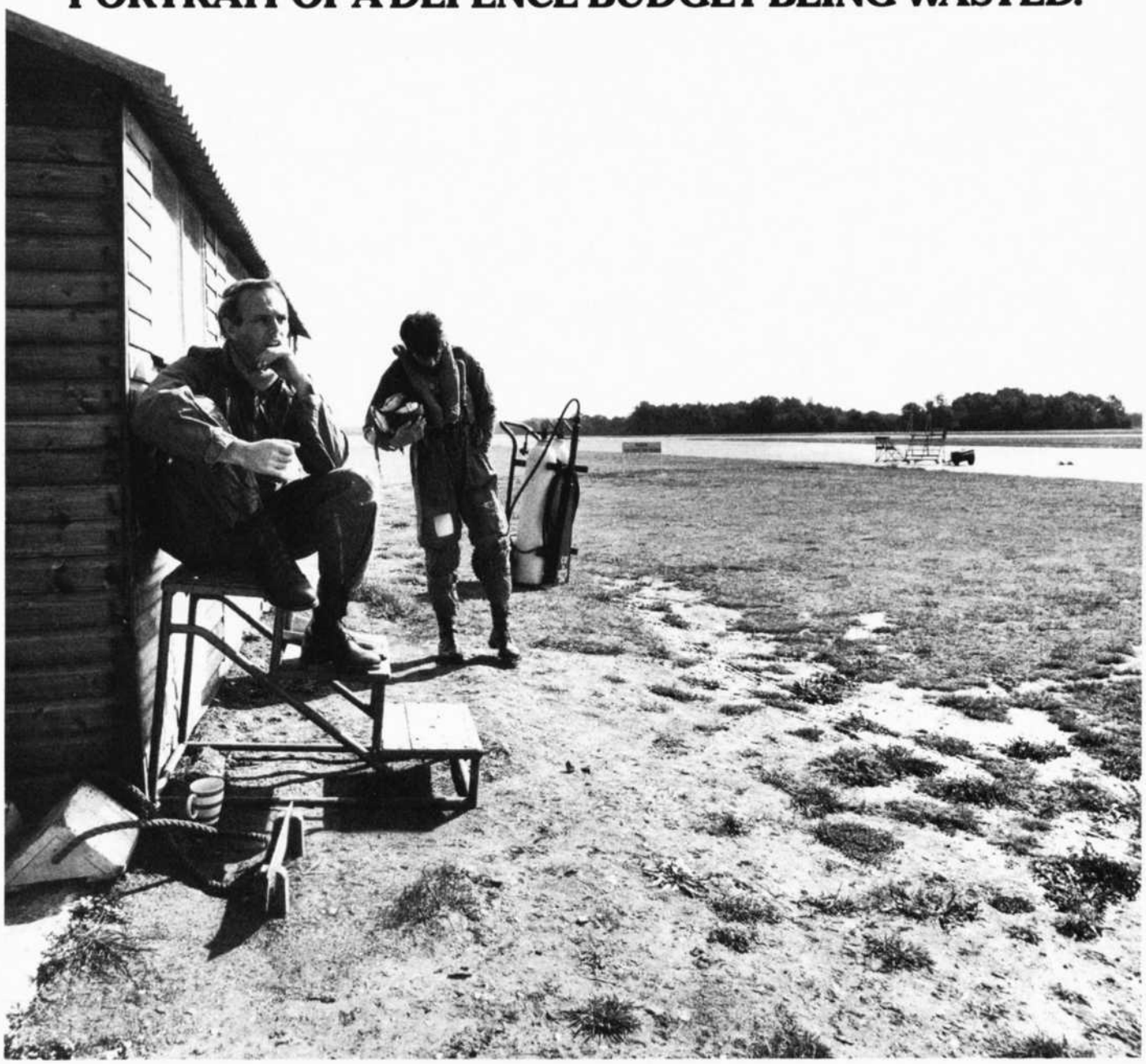

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ROYAL AIR FORCE YEARBOOK 1976

INTRODUCTION

THE Royal Air Force Yearbook appears again this year in a similar format to that established, with great success, last year. Here, again, is a collection of articles embracing the new and the old, the serious and the light-hearted — articles that will give food for thought to readers both within and outside the Royal Air Force itself; articles to stir the blood of past members of the service and to whet the appetites of younger readers aspiring to fly with the RAF — an air arm second-to-none in *esprit de corps* and tradition. These articles, contributed by writers who are each expert in their individual fields, do not necessarily reflect official policy or the views of the Editors or the RAF Benevolent Fund, which organisation benefits from the proceeds of the sale of this Yearbook.

CONTENTS

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RAF SEVENTY SIX—

An up-to-the-minute assessment, by John D R Rawlings, of the RAF's

TO SUGGEST that the Royal Air Force is, in this year of 1976, fighting for its very survival may be an exaggeration; to say that the service is fighting to ensure that it remains capable of doing the job that is its *raison d'être* is certainly a truism. There can today be very few of the Service's personnel, from Air Marshal to Aircraftman, unaware that a conflict is being waged and on the outcome of which relies the continued existence of the Royal Air Force as one of the world's *major* air arms.

The RAF has, of course, faced serious crises before, if perhaps of a less subtle nature than that with which it is contending today. Within a few years of its creation, the service was facing annihilation. The dramatic reduction of armed forces after World War I prompted the older services — from which the RAF had sprung — to fight a sharp political campaign for the dismemberment of the fledgeling and its division between Army and Navy. Defeat of this threat was due in no small part to the obdurate steadfastness of purpose engendered by the "Father of the Royal Air Force", Lord "Boom" Trenchard. The continued existence of the RAF was again threatened in 1940, but this time it was the *Luftwaffe* of Adolf Hitler's Third Reich rather than the RAF's brother services that furnished the menace, and on the fate of the service hinged that of the entire nation.

The outcome of *that* battle for survival is a matter of history. The enemy was an overt one and could be fought in the air. The rationale of the RAF was just such a conflict, but the battle in which the service finds itself today is not one that can be fought with a combination of cannonfire and flying expertise; the enemy is much more insidious and its threat more covert. In fact, two separate battles are being waged simultaneously, one on the economic front and the other on the political, and there can be no gainsaying that their final outcome could be every bit as important to the future well-being of the nation as was that of the most famous battle in the annals of aerial warfare fought out in British skies 36 years ago.

The RAF has been Aunt Sally to successive governments over the past two decades or so. Whenever economies have been called for, the armed forces have been the prime contenders for cutbacks, their personnel strength dwindling in inverse ratio to the size of the *civil* service, and the RAF, being the most technological of the services and, in consequence, the most expensive, has been consistently singled out by governments of the day for the most savage of cuts. The pruning-knife has been wielded for a score or more of years and what *is* remarkable is the fact that, despite steady erosion of manpower and resources, the RAF is *still* a highly potent force and, within the context of NATO, one still fully capable of performing its primary task of safeguarding the nation. But as too drastic pruning will kill the plant, any further application of the pruning-knife in so far as the RAF is concerned could render the whole question of what constitutes a credible air arm purely academic.

Of course, the United Kingdom, currently weathering economic doldrums, can no longer afford to exert the world-wide influence that was once its privilege; with the withdrawal into Europe have come both the need and the opportunity to economise. Within its own housekeeping in recent years, the RAF has undertaken innumerable cost-cutting schemes which have produced savings of many millions of pounds without impairing efficiency, a fact that

THREATS AND FACTS

fighting ability in the light of continuing cuts in defence expenditure

has received little public recognition or credit, and both the machinery and mental approach exist that will enable the service to live with the additional government-imposed economies and reductions already *in* the pipeline with the minimum of operational down-grading. If there are to be *further* strictures on defence, however, a very different picture may emerge . . . !

A year ago, the Defence White Paper announced cuts of £4,760m to be spread over the following 10 years and the implications of such a reduction in defence expenditure between mid-'seventies and mid-'eighties have, after the initial traumatism dissipated, been digested over the past 12 months and the conclusion reached, by the RAF at least, that such economies that are called for, despite their scale, are not inevitably totally disadvantageous. Even in such scenarios as are envisaged today, a highly-trained, morale-high force with the right equipment and an appreciation of the value of flexibility can be a "David" when opposed by

In the forefront of the RAF's armoury for the next decade will be the types illustrated on these pages: above left, the SEPECAT Jaguar GR Mk 1 and McDonnell Douglas Phantom FGR Mk 2 (both of No 14 Squadron); above, Hawker Siddeley Buccaneer S Mk 2As (No 208 Squadron) and below, one of the Panavia Tornado prototypes on test near Blackpool.

The BAC Lightning F Mk 2A (left, No 19 Squadron) will leave service with RAF Germany at the end of 1976, but the F Mk 6 will continue for several more years with No 11 Group for home defence in the UK. Hardened shelters, or "hangarettes", are being provided at all RAF bases in Germany, for aircraft on quick-reaction alert, as illustrated here at RAF Brüggen with a visiting Jaguar from No 6 Squadron.

a very much larger but inflexible and ponderous "Goliath"; the numerical disparity between the opposing forces does not necessarily dictate the outcome. It has thus been the task of the Air Staff to endeavour to ensure that the desired economies can result yet the maximum of operational efficiency be retained, that the training organisation maintains its standards, universally acknowledged to be among the highest in the world, and that morale of the service as a whole be unimpaired.

Faced by the necessity of trimming manpower by no fewer than 18,000 personnel and all the uncertainty and rumour that such a drastic cut generates, the RAF grasped the nettle promptly, establishing with commendable speed the best means of achieving this reduction and informing those personnel affected — altogether, about 4,000 are expected to be made redundant over the next year, a figure which, coupled with natural wastage, will achieve the desired first-stage target in the manpower trimming programme. In general, the policy being adopted is the twofold one of retaining those men of the highest capability and those with the best career prospects, so that the calibre of the service does not suffer and remaining personnel will not have their future hopes — and thus their morale — dashed. Pruning, in this case, is being conducted from the top of the tree downwards, and no redundancies are expected below the rank of sergeant.

Another of the economies which is producing personal problems is the closure of RAF stations. Twelve were scheduled for closure under the 1975 White Paper, and, once again, every effort is being exerted to achieve minimum of disturbance, although some hardship is inevitable. The stations that are being closed are, in the main, those that have been under-utilised or have some environmental disadvantages. For example, such stations as Biggin Hill, Colerne and Driffield have for long been working far below their full capacity, while Little Rissington has runways that are rather on the short side for the Gnats that the CFS operates (from Kemble) and Thorney Island has long been a bone of contention with the local holiday resorts from the viewpoint of noise. These are typical of the considerations

RAF GERMANY

RAF Germany is very much the front-line of the RAF today, being the UK's major contribution to NATO and providing the forward units of defence against the East. This Command is in process of updating both its strike force and its air defence force. The Jaguar GR Mk 1 is taking the place of the Phantom FGR Mk 2 as the strike aircraft and the Phantom FGR Mk 2 is in turn being re-phased into the air defence rôle to succeed the Lightning F Mk 2A. This updating should be substantially complete by the end of 1976.

The current strength of RAF Germany, in terms of aircraft types and units, is as follows:

HS Harrier GR Mk 1A/GR Mk 3: RAF Germany has one Wing of Harriers for close battlefield support and for dispersal in the field, taking advantage of the Harrier's unique capability. At present, this wing, comprising Nos 3, 4 and 20 Squadrons, is stationed at Wildenrath but at the end of this year it will move east to Gutersloh. In due course the Wing will be reorganised on a two-squadron basis (although overall aircraft numbers will remain the same), by the disbandment of No 20 Squadron.

BAC Lightning F Mk 2A: The air defence force of RAF Germany at present comprises a Lightning Wing at Gutersloh consisting of Nos 19 and 92 Squadrons. During the second half of 1976, these units will move west to Wildenrath where they will be re-equipped with Phantoms, the Lightning then being phased out of RAF Germany by the end of the year.

McDonnell Douglas Phantom FGR Mk 2: Until this year, the Phantom has formed the main strike force of RAF Germany, with a Wing at Brüggen comprising Nos 14, 17 and 31 Squadrons, and an additional Squadron, No 2, at Laarbruch flying primarily in the reconnaissance rôle. Replacement of the Brüggen Wing by Jaguars will be completed during 1976, as will also re-equipment of the recce squadron at Laarbruch. The Phantom FGR Mk 2 will this year re-appear in RAF Germany, but in the air defence rôle, replacing the Lightning F Mk 2A first in No 19 Squadron and then in No 92 Squadron at Wildenrath.

Hawker Siddeley Buccaneer S Mk 2B: This aircraft equips one strike bomber Wing in RAF Germany, based at Laarbruch and comprising Nos 15 and 16 Squadrons. It provides the heaviest offensive support of any of the types in Germany.

SEPECAT Jaguar GR Mk 1: The Jaguar is the new standard strike aircraft for RAF Germany and its re-equipment of the Brüggen Wing (Nos 14, 17 and 31 Squadrons), well advanced by the Spring of 1976, will be completed this year. No 2 Squadron at Laarbruch is also re-equipping, in the strike/reconnaissance rôle, and a fifth squadron will in due course be re-formed in RAF Germany with the Jaguar; this will be No 20 Squadron.

Westland Wessex HC Mk 2: There has been no recent change in the helicopter support force in RAF Germany, which comprises the 15 Wessex HC Mk 2s of No 18 Squadron based at Gutersloh.

Communications Aircraft: There is one communications squadron, No 60, based at Wildenrath, equipped with eight BAC Pembroke C Mk 1 aircraft.

Surface-to-Air Missiles: In addition to four squadrons of the RAF Regiment using the Rapier for airfield defence, the RAF has No 25 Squadron equipped with BACGW Bloodhound Mk 2 missiles in RAF Germany.

Hawker Siddeley Buccaneers, in the Martel-equipped S Mk 2B version, equip one strike bomber Wing in RAF Germany and provide the heaviest offensive support of any German-based types. Aircraft of No 15 Squadron are illustrated.

that have provided reasons for selecting for closure Bicester, Biggin Hill, Chessington, Colerne, Driffield, Hullavington, Leconfield, Little Rissington, Medmenham, Tern Hill, Thorney Island and West Raynham. In addition, the flying units have left Cottesmore, although the service does not propose to relinquish this airfield at present.

As a result of the government review of Public Expenditure to 1980, additional savings on the defence budget of £534m in the next three years have been ordered. So far as the RAF is concerned, these extra cuts involve the closing of MUs at Aldergrove and Sydenham and reductions in spares and engineering support, communications and radars and works expenditure.

It is by such measures as these that the economic threat to the service is so far being contained, but the other threat is a particularly difficult one for an armed service to combat in times of peace as it manifests itself in an intangible fashion; the threat posed by those who, either through unrealistic ideological beliefs or for downright disruptive political motives, wish to reduce the armed forces of the United Kingdom to impotency in the face of the rapidly-growing military might of those nations whose openly-professed credo is world domination. This is not a threat that can be countered by economies; it can be nullified, not only by forthrightness and plain-speaking by those who have the knowledge and position within the services, but by the protestations of everyone cherishing their freedom.

Turning to the combat capability of the RAF, it can be claimed with justification that, despite the stringest economies that are being imposed, the first-line operational potential of the service within the context of the European theatre has not diminished by any measure; admittedly, the rate of re-equipment of first-line elements with certain new types of aircraft is being slowed in order to spread the capital expenditure over an extended span of time, but at least production of the Panavia Tornado (MRCA) has escaped the threat of cancellation and development of the air defence version (ADV) is being allowed to proceed — air defence elements of the RAF are being updated at present, although they are receiving a fighter that is itself 15 years old, and the need for the Tornado ADV is manifest.

Meanwhile, the Phantom, which, in its FGR Mk 2 version, has been the standard strike aircraft in both RAF Germany and Strike Command for many years, is replacing the BAC Lightning in the air defence rôle — a process that will be complete by the end of this year. One RAF station, Binbrook in Lincolnshire, will keep two squadrons of Lightnings in service until the advent of Tornado in the air defence rôle, to take advantage of the special capabilities of the BAC aircraft and maintain a degree of flexibility. As a get-up-and-go fighter, capable of getting to operational altitude and into action quickly, the Lightning is superior

HOME DEFENCE

Defence of the UK is in the hands of No 11 Group, Strike Command, which operates both missiles and aircraft for this task. It is engaged in 1976 in the process of replacing most of its Lightnings by Phantoms in this rôle, and re-activating the Bloodhound SAM. In addition to its seven fighter squadrons it operates an early-warning squadron and several second-line units.

BAC Lightning: The Lightning has, in its F Mk 3 and F Mk 6 forms, been the mainstay of UK defence for many years. By the beginning of this year, however, only three Lightning squadrons remained, Nos 5 and 11 at Binbrook, Lincolnshire, and No 56 at Wattisham, Suffolk. It is planned to retain the two-squadron Wing at Binbrook into the 'eighties as the final RAF units operating the Lightning. No 56 Squadron at Wattisham is re-equipping with Phantoms during the year.

McDonnell Douglas Phantom FG Mk 1: When the Fleet Air Arm's fixed-wing force was severely reduced in 1969, the RAF took over 20 Phantom FG Mk 1s and re-formed No 43 Squadron at Leuchars, Fifeshire. This squadron remains an integral part of UK defence and should be supplemented by a second similarly-equipped squadron when HMS *Ark Royal* ends its days in the late 'seventies and its No 892 Squadron disbands.

McDonnell Douglas Phantom FGR Mk 2: Beginning in 1975, this type, already in service with the RAF as a strike aircraft, has been re-worked as the UK's primary air defence aircraft. Nos 29 and 111 Squadrons became operational last year and are now based at Coningsby, Lincolnshire, and Leuchars respectively. No 23 Squadron has become operational at Wattisham this year and will be joined there by No 56 when it has re-equipped from Lightnings.

HS Shackleton AEW Mk 2: Early warning duties for UK defence are performed by 12 Shackleton AEW Mk 2s, converted from the maritime reconnaissance rôle by fitting AN/APS-20(F)1 radar and other new equipment. These equip No 8 Squadron at Lossiemouth, Scotland, but their life is limited and they will need to be replaced in the foreseeable future, probably by either an AEW version of the Nimrod or the US Boeing E-3A AWACS aircraft.

BAC Canberra: Two second-line squadrons are maintained by No 11 Group to provide targets for radar units, fighter squadrons, anti-aircraft units and for Army and Navy requirements. These units fly various versions of the Canberra, the B Mk 2, TT Mk 18 and T Mk 19 being the principal versions used. Both units are lodgers on airfields belonging to other groups — No 7 Squadron is based at St Mawgan (18 Group) in Cornwall and No 100 at Marham (1 Group) in Norfolk.

Surface-to-Air Missiles: In December 1975, No 85 Squadron was reformed at West Raynham, Norfolk with BACGW Bloodhound Mk 2 surface-to-air missiles for UK defence, with detached sites at Bawdsey and North Coates. A fourth site will be added later.

(Above) The HS Shackleton AEW Mk 2 equips the only RAF squadron dedicated to the airborne early-warning rôle, this being No 8 Squadron. (Below) Target facilities are provided by various marks of English Electric Canberra, including this TT Mk 18 of No 7 Squadron.

STRATEGIC STRIKE

No 1 Group, Strike Command, is the group which controls the strategic strike element of the RAF in the UK, an element which is entirely allocated to NATO for its use. Unlike other groups, No 1 is not engaged in re-equipping or re-forming squadrons at present and will remain in its present stable form until the advent of Tornado in a few years' time. In addition to the strike units *per se*, the Group operates the tanker force and supervises the photo-reconnaissance elements in the UK.

Hawker Siddeley Vulcan B Mk 2: The last of the RAF's V-Bombers, the Vulcan still comprises the main part of the Group's long-range strike force and will do so until replaced by the Tornado in the 'eighties. It operates in both nuclear and conventional rôles and occupies two bases. Waddington, in Lincolnshire, houses Nos 9, 44, 50 and 101 Squadrons, all operating in the straight bomber rôle. Scampton, also in Lincolnshire, houses the Operational Conversion Unit (No 230), No 27 Squadron which uses the Vulcan in the Strategic Reconnaissance rôle world-wide, and Nos 35 and 617 Squadrons which are straight bomber squadrons.

Hawker Siddeley Buccaneer S Mk 2: The other current strike bomber in the RAF is the Buccaneer, which is based at Honington in Suffolk. The wing comprises the OCU (No 237) and at present two squadrons, No 12 which has Martel-equipped S Mk 2B Buccaneers and which has a maritime strike rôle in addition to its NATO tasks, and No 208 which does not have the maritime rôle. In a few years' time a third squadron will be formed from the Buccaneers available when HMS *Ark Royal*'s No 809 Squadron (also shore-based at Honington) disbands.

Hawker Siddeley (HP) Victor: This ex-V-Bomber equips the RAF's tanker force in both K Mk 1 and K Mk 2 versions. The tanker Wing is based at Marham, Norfolk, where there is an OCU (No 232) and three squadrons, Nos 55, 57 and 214. The Wing is in process of replacing the earlier K Mk 1 version with the K Mk 2, No 55 Squadron being the first to switch.

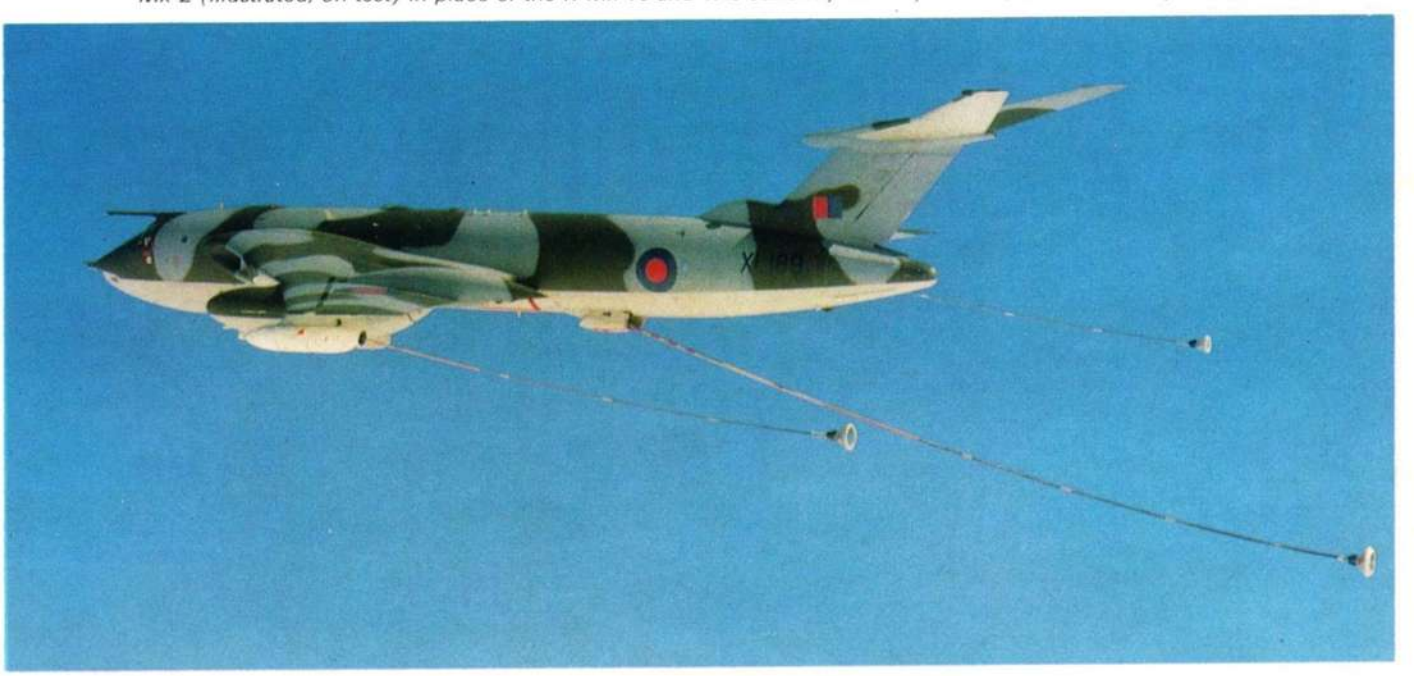
BAC Canberra: This perennial RAF aircraft still serves in 1 Group in several rôles. Principal operational rôle is photo-reconnaissance, provided by No 39 Squadron at Wyton in Huntingdon with both PR Mk 7 and PR Mk 9 versions. These types are also used by No 13 Squadron at Luqa, Malta, but this unit will be disbanded within the next three years. Two other units fly other versions of the Canberra at Wyton: No 51 Squadron using a few B Mk 6s on special duties and No 360 Squadron (a joint RAF/RN unit) flying the Canberra T Mk 17 version on ECM training duties. RAF Marham is the home of the Canberra OCU (No 231) and No 100 Squadron of 11 Group (see Home Defence).

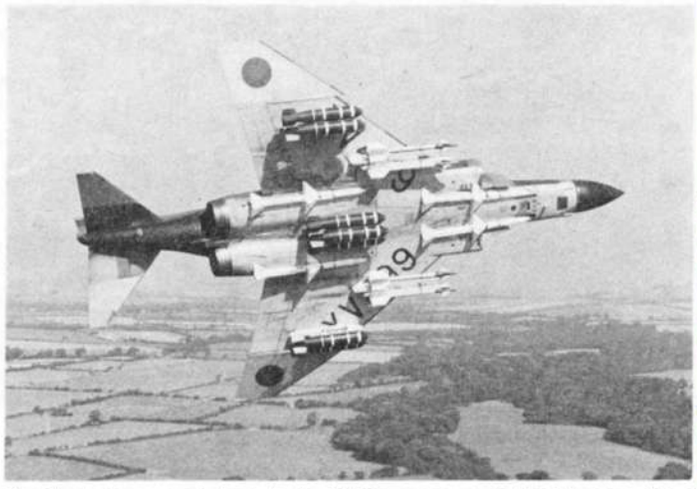
To be replaced by the Panavia Tornado, the HS Vulcan B Mk 2 remains the largest of the RAF's offensive aircraft. Illustrated is an aircraft of No 27 Squadron on a routine patrol mission over a North Sea oil rig, this activity being one of the RAF's special commitments.

to the Phantom but is definitely short on range and firepower (having only two missiles and the option of two 30-mm cannon), whereas the McDonnell Douglas aircraft can tote a variety of missiles and has the quick-firing 20-mm gun pod, together with underwing tanks to supplement capacious internal tankage which give it a very much more useful endurance. The Phantom air defence squadrons will be using Leuchars in Scotland, Wattisham in Suffolk, Coningsby in Lincolnshire and Wildenrath in Germany — a more flexible adjustment of the air defence capability made for operational rather than economic reasons. The only effect of economies on this force will be some delay in the eventual replacement of the Phantoms and Lightnings by the MRCA.

The Phantoms have been made available for air defence by the introduction into RAF service of the Anglo-French Jaguar GR Mk 1 strike aircraft. This has now become the standard offensive support vehicle of the Service, already equipping the strike wing in the UK (at Coltishall) and to be phased in, during this year by all the former Phantom squadrons in Germany engaged in strike duties. Jaguars will also equip the tactical reconnaissance squadrons (one in Germany and one in the UK) with the introduction into service of the special photo-recce pack for use with this aircraft. When this programme is complete, the strike force in Germany will contain one additional Jaguar squadron

The RAF's flight refuelling tanker force is in process of being modernised, and its capabilities extended, by the introduction of the Victor K Mk 2 (illustrated, on test) in place of the K Mk 1s and 1As currently used by Nos 55, 57 and 214 Squadrons.





(Left) An important item in the RAF's armoury is the Hunting BL 755 cluster bomb, seven of which are seen on this No 41 Squadron Phantom FGR Mk 2 together with four Sparrow and four Sidewinder AAMs. Adopted by six NATO nations, the BL755 ejects over 100 "bomblets" for maximum effectiveness against ground targets. (Right and below) HS Harrier GR Mk 3s of No 1 Squadron on detachment to Belize late in 1975, when civil disturbances on the island required a military presence from the UK.

over and above the equivalent Phantom inventory and this programme has not been affected by the defence cuts.

For battlefield support, the RAF uses the unique Hawker Siddeley Harrier V/STOL aircraft and there is likely to be no change in the overall strengths of the UK and German-based Harrier forces. Those in Germany are moving eastwards to Gutersloh this year and in due course will be regrouped in two squadrons instead of three as at present, although the overall size of the forces will not alter.

Today's equivalent of Bomber Command comprises the Vulcan and Buccaneer squadrons of the RAF, mostly based in the UK but with a wing of two Buccaneer squadrons at Laarbruch in Germany. Until the withdrawal from Cyprus last year, a wing of Vulcans was based at Akrotiri, attached to the CENTO forces, but these two squadrons were withdrawn to the UK and now reinforce the main long-range bomber force based in traditional "bomber country" at Waddington and Scampton in Lincolnshire. These two famous bases support six straight bomber squadrons, a strategic recce squadron and the OCU, all equipped with Vulcans, and these sturdy veterans, now fulfilling a hard-hitting low-level rôle, maintain a viable and potent long-distance strike force until their replacement in the late 'seventies by the Tornado.

Backing up the Vulcans are the Buccaneers, both in Germany and at Honington in Suffolk, and these, too, provide a viable strike force into the 'eighties. One of the two squadrons at Honington is assigned to SACLANT for maritime strike duties, a rôle for which the Buccaneer was originally evolved for the Fleet Air Arm, and, in fact, Honington is also used by the one remaining RN Buccaneer squadron, No 809, until HMS *Ark Royal* is phased out, when this unit will swell the RAF inventory of offensive Buccaneers.

From the foregoing it can be seen what a vital factor over the next few years will be the introduction of the Tornado; virtually all the RAF's eggs are in this one basket and any alteration to the Tornado programme will have the most profound effect on the whole future of the Service. So far, the only inroad into this programme as originally planned, due to economies, has been the slowing of deliveries of the air defence version. The programme remains the biggest and perhaps the most fundamental re-equipment that the Royal Air Force has undertaken in terms of one aircraft fulfilling most of the major operational functions within the Service.

On the maritime front, successive cuts of the last few years have drastically reduced the area of sea which the Royal Air Force is committed to patrolling (though not, of

TACTICAL STRIKE

Whilst the RAF's main strike force is in RAF Germany, it maintains a second such force in the UK under No 38 Group, which is also NATO-assigned but can in addition be used for other purposes as HM Government deems fit. For example, a detachment from one of its units (No 1 Squadron) was operational in Belize, British Guiana, late in 1975 as part of the ACE Mobile Force. This Group has almost completed the replacement of its Phantoms by the Jaguar as its principal strike aircraft. It also operates the tactical helicopters of the RAF (see Helicopters).

McDonnell Douglas Phantom FGR Mk 2: Coningsby in Lincolnshire has been the main 38 Group Phantom base for many years and still houses the OCU (No 228) and 38 Group's last remaining strike Phantom squadron, No 41. This unit is a specialised strike/reconnaissance unit like No 2 in Germany and will in due course re-equip with a recce version of the Jaguar. The OCU is now more concerned with air defence training on the Phantom than with strike training.

SEPECAT Jaguar GR Mk 1: Since 1973 this type has taken over the main tactical strike commitments in the RAF. It is used by the OCU (No 226) at Lossiemouth in Scotland and by the Jaguar Wing at Coltishall in Norfolk, comprising at present Nos 6 and 54 Squadrons. They will be joined by a third squadron, No 41, later in 1976 in the strike/recce rôle.

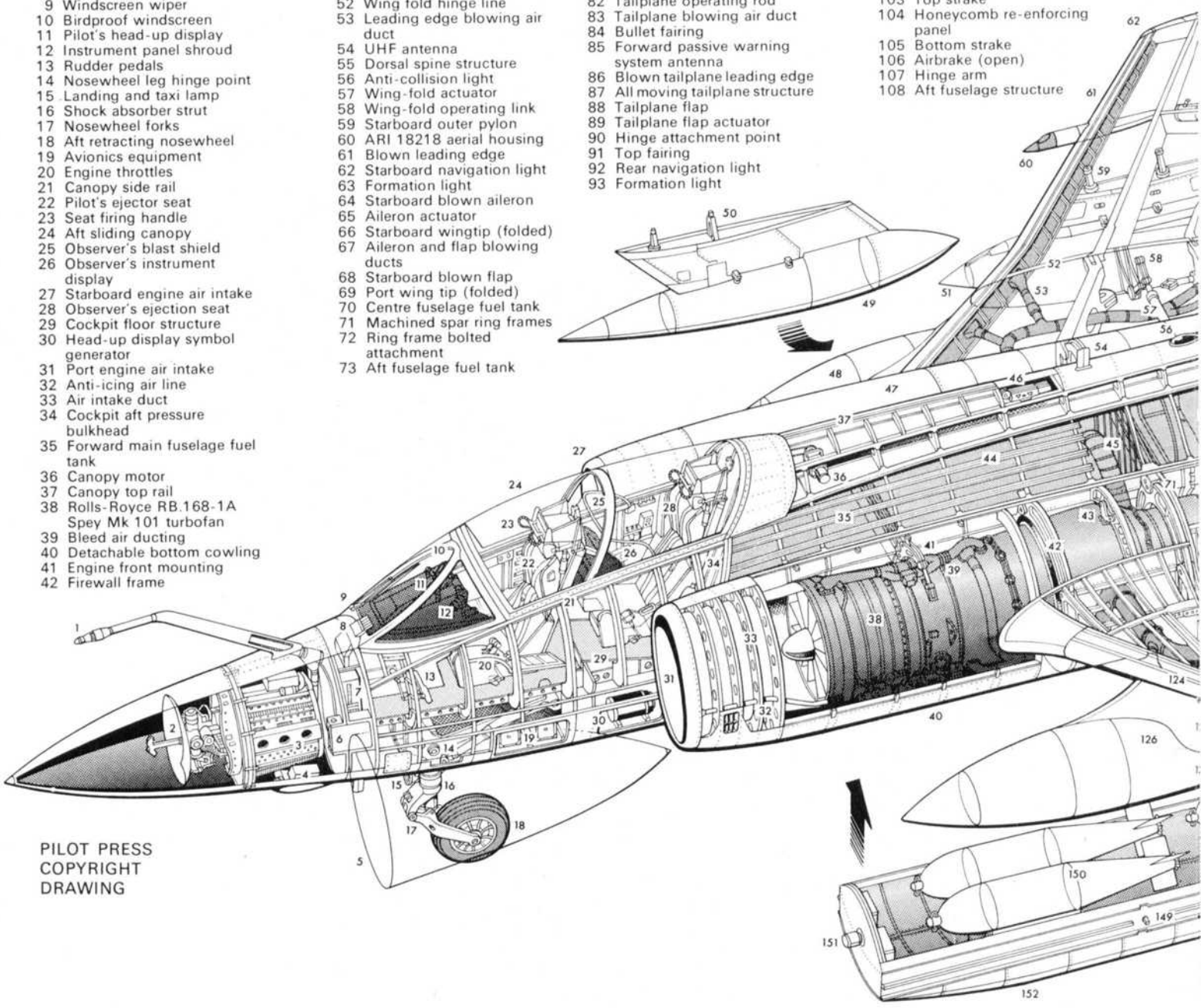
HS Harrier GR Mk 3: In addition to the Jaguars, No 38 Group maintains one squadron of Harriers in the UK for NATO reinforcement and for use by the ACE Mobile Force. This is No 1 Squadron, stationed at Wittering, Northants, together with the OCU (No 233).

HS Hunter FGA Mk 9: Also maintained at Wittering is a Wing of Hunter strike fighters, used mainly for keeping a pool of experienced strike pilots at operational pitch but also available for operations if necessary. The Squadrons in this Wing are Nos 45 and 58. The Hunter F Mk 6A and FGA Mk 9 are also flown by the Tactical Weapons Unit at Brawdy, Pembrokeshire, whose purpose is to provide pre-OCU tactical training. It also maintains a detachment of Hunters at Gibraltar.

course, the amount of sea through which our seaborne supplies and raw materials need to travel, in peace or war) so there is likely, on paper, to be a surplus of Nimrod maritime reconnaissance aircraft now that the Singapore detachment has been phased out and the withdrawal of the Nimrod force based on Malta is foreseen within the next year or two. However, all the Nimrods within the four UK squadrons (three at Kinloss in Scotland and one at St Mawgan in Cornwall) will be going back to the manufacturers to be updated as Mk 2 aircraft with considerably improved search and attack equipment, so it is reasonable to assume that any "surplus" aircraft will be filling the gaps in the squadrons until the Mk 1s have all been transformed as Mk 2s. Another possible use for the Nimrods is already in view, however, for at present the UK defence force relies upon one squadron of Shackleton AEW Mk 2s at Lossiemouth for the whole of its airborne early-warning radar chain; these aircraft were introduced at the beginning of 1972 largely as an interim measure, being re-worked airframes some of which had first flown in the early 'fifties, and they cannot be expected to continue in this task for very much longer. With surplus airframes (in the shape of the excess Nimrods) which could relatively easily be adapted to AEW duties and sufficient floor space and production

Hawker Siddeley Buccaneer S Mk 2B Cutaway Drawing Key

1 In-flight refuelling probe
2 Radar scanner
3 Multi-mode search and fine control radar
4 Weapon recorder
5 Radome (folded)
6 Radome hinge
7 Weapon release computer
8 Windscreen rain dispersal duct
9 Windscreen wiper
10 Birdproof windscreen
11 Pilot's head-up display
12 Instrument panel shroud
13 Rudder pedals
14 Nosewheel leg hinge point
15 Landing and taxi lamp
16 Shock absorber strut
17 Nosewheel forks
18 Aft retracting nosewheel
19 Avionics equipment
20 Engine throttles
21 Canopy side rail
22 Pilot's ejector seat
23 Seat firing handle
24 Aft sliding canopy
25 Observer's blast shield
26 Observer's instrument display
27 Starboard engine air intake
28 Observer's ejection seat
29 Cockpit floor structure
30 Head-up display symbol generator
31 Port engine air intake
32 Anti-icing air line
33 Air intake duct
34 Cockpit aft pressure bulkhead
35 Forward main fuselage fuel tank
36 Canopy motor
37 Canopy top rail
38 Rolls-Royce RB.168-1A Spey Mk 101 turbofan
39 Bleed air ducting
40 Detachable bottom cowling
41 Engine front mounting
42 Firewall frame
43 Engine aft mounting
44 Forward fuselage structure
45 Bleed air cross-over duct
46 Canopy hand winding shuttle
47 Detachable engine top cowling
48 Starboard slipper tank
49 Data link acquisition pod
50 Data link inboard pylon
51 Martel air-to-surface missile
52 Wing fold hinge line
53 Leading edge blowing air duct
54 UHF antenna
55 Dorsal spine structure
56 Anti-collision light
57 Wing-fold actuator
58 Wing-fold operating link
59 Starboard outer pylon
60 ARI 18218 aerial housing
61 Blown leading edge
62 Starboard navigation light
63 Formation light
64 Starboard blown aileron
65 Aileron actuator
66 Starboard wingtip (folded)
67 Aileron and flap blowing ducts
68 Starboard blown flap
69 Port wing tip (folded)
70 Centre fuselage fuel tank
71 Machined spar ring frames
72 Ring frame bolted attachment
73 Aft fuselage fuel tank
74 Electrical cable ducting in dorsal spine
75 Avionics equipment bay
76 Air data computer
77 HF notch aerial
78 Equipment bay cooling air intake
79 Fin spar attachment
80 Fin structure
81 Tailplane actuator
82 Tailplane operating rod
83 Tailplane blowing air duct
84 Bullet fairing
85 Forward passive warning system antenna
86 Blown tailplane leading edge
87 All moving tailplane structure
88 Tailplane flap
89 Tailplane flap actuator
90 Hinge attachment point
91 Top fairing
92 Rear navigation light
93 Formation light
94 Aft passive warning system antenna
95 Port tailplane flap
96 Rudder structure
97 Rudder operating link
98 Rudder actuator
99 Airbrake jack
100 Drag-link hinge attachment
101 Airbrake operating slide
102 Split tailcone airbrake
103 Top strake
104 Honeycomb re-enforcing panel
105 Bottom strake
106 Airbrake (open)
107 Hinge arm
108 Aft fuselage structure



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DRAWING

capacity available in the industry, it seems to many that the obvious solution is to marry this requirement to the Nimrod; the alternative, to buy the Boeing E-3A AWACS, is likely to be very much more costly and will neither solve the surplus Nimrod problem nor help with the UK's current unemployment difficulties, but the relative capabilities of the two aircraft, and the standardisation of equipment within NATO, have to be weighed in the balance.

Most of the RAF's reconnaissance force has already been mentioned, the remainder of this task being the responsibility of two Canberra squadrons, one at Wyton in Huntingdon and one on Malta. The latter is likely to be disbanded when Luqa, the Maltese base, is closed before the end of this decade, but the UK squadron is expected to fly on with the perennial Canberra for some years yet, performing a host of PR duties. Other Canberras also serve on ECM training (at Wyton) and on target facilities duties (at St Mawgan and Marham). The defence cuts have, in fact, affected the Canberra units in that a radar calibration unit at Cottesmore has been disbanded, as has one of the two target facilities units at West Raynham; with the closure of the latter base the other unit has moved to Marham, as has also the OCU for Canberras which was previously at Cottesmore.

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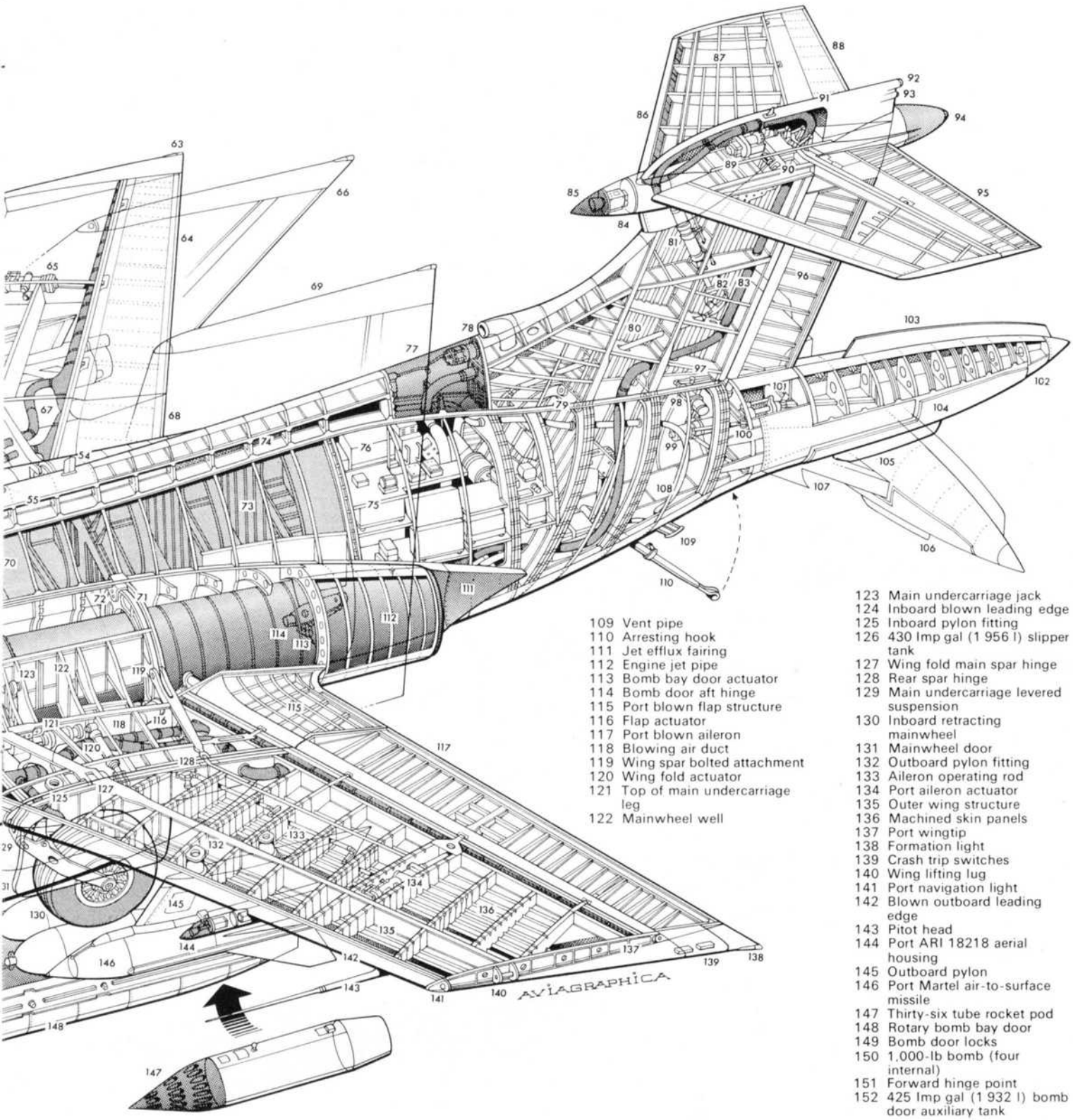
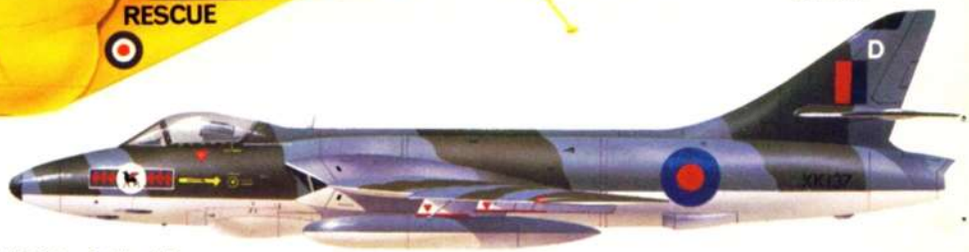
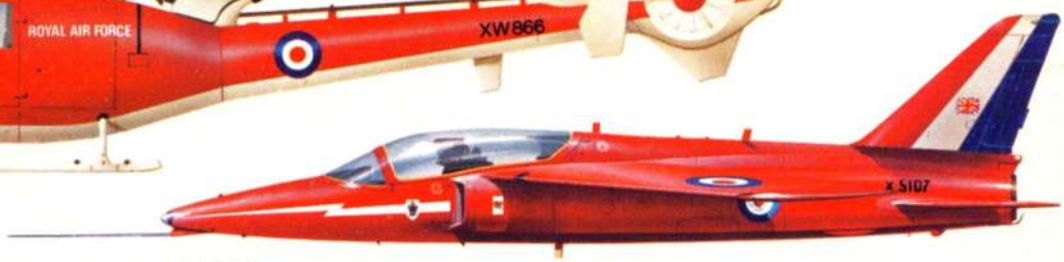


109 Vent pipe
110 Arresting hook
111 Jet efflux fairing
112 Engine jet pipe
113 Bomb bay door actuator
114 Bomb door aft hinge
115 Port blown flap structure
116 Flap actuator
117 Port blown aileron
118 Blowing air duct
119 Wing spar bolted attachment
120 Wing fold actuator
121 Top of main undercarriage leg
122 Mainwheel well
123 Main undercarriage jack
124 Inboard blown leading edge
125 Inboard pylon fitting
126 430 Imp gal (1 956 l) slipper tank
127 Wing fold main spar hinge
128 Rear spar hinge
129 Main undercarriage levered suspension
130 Inboard retracting mainwheel
131 Mainwheel door
132 Outboard pylon fitting
133 Aileron operating rod
134 Port aileron actuator
135 Outer wing structure
136 Machined skin panels
137 Port wingtip
138 Formation light
139 Crash trip switches
140 Wing lifting lug
141 Port navigation light
142 Blown outboard leading edge
143 Pitot head
144 Port ARI 18218 aerial housing
145 Outboard pylon
146 Port Martel air-to-surface missile
147 Thirty-six tube rocket pod
148 Rotary bomb bay door
149 Bomb door locks
150 1,000-lb bomb (four internal)
151 Forward hinge point
152 425 Imp gal (1 932 l) bomb door auxiliary tank

(Left) Westland Whirlwind HAR Mk 10 XP346 of No 22 Squadron, which provides detached flights for SAR at Brawdy, Chivenor, Coltishall and Valley.



(Above right) Hawker Hunter FGA Mk 9 XK137 of No 45 Squadron, one of two such units in No 38 Group at RAF Wittering. Hunters are also used in several specialised training rôles in the UK and Gibraltar.



(Above) Westland/Aérospatiale Gazelle HT Mk 3 XW866 of the Central Flying School's Helicopter Wing, which provides all RAF helicopter pilot training at Shawbury.

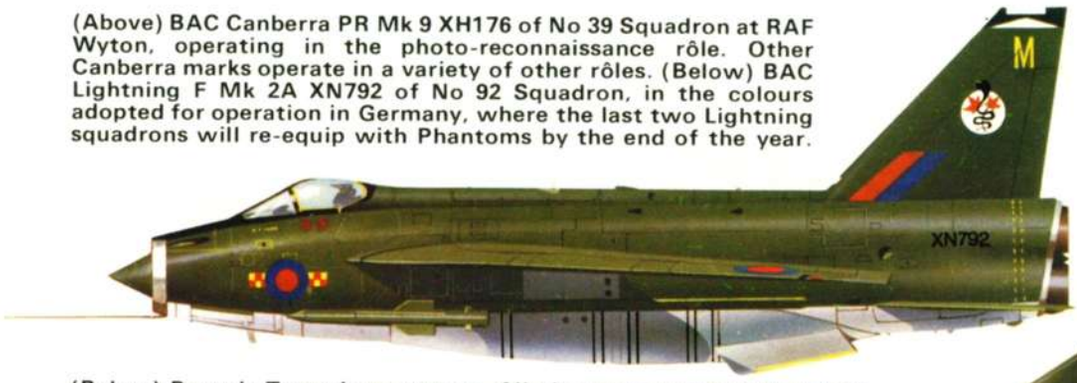
(Above) Hawker Siddeley Gnat T Mk 1 XS107 in the markings of the Red Arrows aerobatic team, based at Kemble. For advanced jet pilot training, the Gnat is still in use at No 4 FTS at RAF Valley, where the CFS Gnats are also now based.

(Above) BAC Jet Provost T Mk 5A XW417, as used at the RAF College, Cranwell. The type is also in service with the CFS at Cranwell, No 1 FTS, No 6 FTS and No 26 Squadron. (Right) Scottish Aviation Bulldog T Mk 1 XX543 of No 2 FTS. The type is also used by CFS at Little Rissington and the University Air Squadrons.

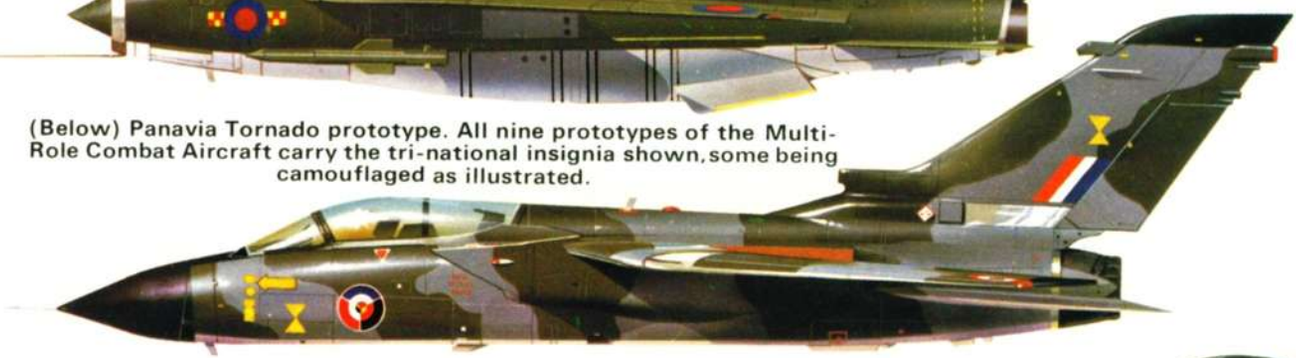
(Left) De Havilland Canada Chipmunk T Mk 10 WB550. The Chipmunk remains in use primarily in Air Experience Flights for the benefit of the ATC and CCF. (Below) Hawker Siddeley Hawk T Mk 1 XX157, a prototype of the new trainer destined for service at No 4 FTS and the CFS.

(Below) SEPECAT Jaguar GR Mk 1 XX721 in the markings of No 54 Squadron, one of the two units making up Coltishall's Jaguar Wing. Four squadrons will be equipped on the Jaguar in RAF Germany by end-1976, with one more in Germany and one more in the UK to equip in 1977.

(Above) BAC Canberra PR Mk 9 XH176 of No 39 Squadron at RAF Wyton, operating in the photo-reconnaissance rôle. Other Canberra marks operate in a variety of other rôles. (Below) BAC Lightning F Mk 2A XN792 of No 92 Squadron, in the colours adopted for operation in Germany, where the last two Lightning squadrons will re-equip with Phantoms by the end of the year.



(Below) Panavia Tornado prototype. All nine prototypes of the Multi-Role Combat Aircraft carry the tri-national insignia shown, some being camouflaged as illustrated.



(Below) Hawker Siddeley Buccaneer S Mk 2B XW549 of No 16 Squadron, which with No 15 Squadron forms a strike bomber wing at RAF Laarbruch in Germany. Two other squadrons are home-based.

(Below) Hawker Siddeley Harrier GR Mk 3 XV800 of No 20 Squadron, one of three units in the Harrier Wing at RAF Gutersloh in Germany; this unit will soon disband to make the Wing a standard two-squadron component, retaining the same number of aircraft. One other Harrier squadron is UK-based, operating within No 38 Group from RAF Wittering.

(Below) McDonnell Douglas Phantom FGR Mk 2 XV500 of No 111 Squadron at RAF Coningsby, one of the former Lightning-equipped squadrons now responsible, within No 11 Group, for Home Defence.

NOT TO SCALE

In "appalling" weather...

A Jaguar of No 14 Squadron of the Royal Air Force which put up the best individual performance in the Salmond Trophy navigation and bombing competition arrived dead overhead of target, dead on time, and scored a direct hit. The weather was officially described as "appalling".

Jaguar – the best tactical strike aircraft in existence.

jaguar Designed and built by **S.E.P.E.C.A.T.**

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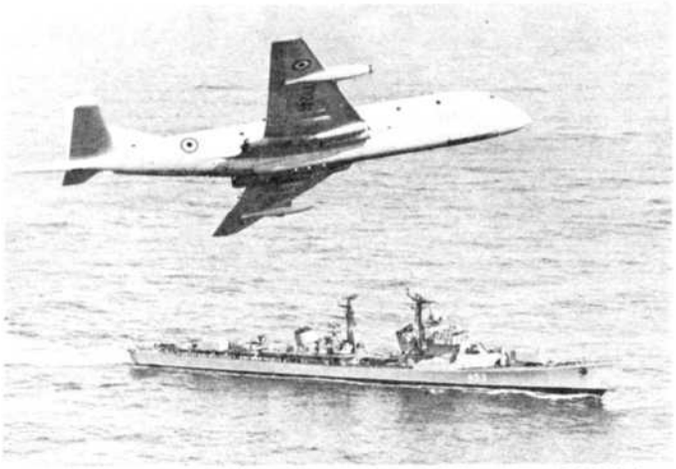

A Hawker Siddeley Nimrod MR Mk 1 of No 206 Squadron, RAF Kinloss, flies over a Soviet guided missile destroyer in the Orkneys area. Maritime patrol Nimrods keep a constant watch on ships around Britain's shores.

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The biggest cuts in aircraft strength have been suffered by the transport force of No 38 Group, Strike Command. This Group was built up largely for two purposes; the regular support of the RAF's overseas commitments (and, of course, those of the other two services) and the provision of tactical transport for NATO and the ACE Mobile Force, ready to move anywhere at short notice. With the virtual elimination of all Britain's overseas military commitments, the long-range branch of 38 Group, comprising one Comet squadron, two Britannia squadrons, one Belfast squadron and one VC10 squadron, was clearly underemployed. Significant savings have therefore been made by eliminating the older aircraft; the Comets have already been sold and the Britannias are on the market, some having already gone into commercial service. The VC10 squadron has been reduced from 13 to nine aircraft and the Belfast squadron, the only heavy-duty freighter unit, is to be withdrawn in November. Most numerous single aircraft type in the transport force is thus the Hercules, of which 66 were

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MARITIME

A former Coastal Command group, No 18 Group is now Strike Command's unit with responsibilities for anti-submarine warfare as well as protection of the sea routes, oil-rig patrols, search and rescue, and subsidiary duties. For its main maritime task the Group uses the Hawker Siddeley Nimrod MR Mk 1 flying from two UK bases, Kinloss in Morayshire, Scotland, and St Mawgan in Cornwall. The latter base houses the OCU (No 236) and one operational squadron, No 42. Kinloss houses three operational squadrons (Nos 120, 201 and 206) and there is at present a fifth squadron, No 203, at Luqa, Malta, which will disband before the end of the decade. It is intended to replace these aircraft with the Nimrod MR Mk 2 version which will, in substance, be the same aircraft with very much updated search equipment, including a new ASV radar, the EMI Search-water. No. 18 Group also controls the rescue squadrons which are dealt with under the "Helicopters" heading. In peacetime, the Nimrod squadrons also maintain a long-range SAR commitment to support the helicopters. In addition, three Nimrod R Mk 1s are operated, within No 1 Group, by No 51 Squadron at Wyton for special duties.

The Westland Wessex equips three full RAF squadrons, including No 18 in Germany, where this picture was taken during an exercise at a field site. The Wessex is also in use for search and rescue duties around the UK.

HELICOPTERS

Helicopters in the RAF operate in three basic rôles and are divided amongst the groups concerned. Most numerous are the tactical support helicopters of No 38 Group (see "Tactical Strike" also) which fly in the battlefield rôle alongside the Harrier and Jaguar squadrons. Two types are used — the Westland Wessex HC Mk 2 and the Westland/Aérospatiale Puma HC Mk 1. The Group's helicopter headquarters is at RAF Odiham, Hants, where all the units also have their headquarters. From there they move out on detachment, being largely Army-orientated. Thus, they are heavily committed in Northern Ireland, but will also be found wherever the Army is exercising or operating.

The Wessex Squadron (No 72) in 38 Group also operates a SAR flight as an interim measure from Manston in Kent, although the main SAR commitment is operated by two 18 Group squadrons, Nos 22 and 202, based at eight sites around the UK, and at present equipped with Westland Whirlwinds HAR Mk 10s. These are due to be supplanted at two sites during 1976 by Wessex 2s, and from late 1977 onwards by 15 Westland Sea King HAR Mk 3s at four other sites (probably Coltishall, Boulmer, Lossiemouth and Brawdy).

The third rôle in which the helicopter serves is that of short-range communications, a small number of Whirlwind HC Mk 10s being operated by No 32 Squadron at Northolt for this purpose.

All helicopter training for the RAF is carried out by the Central Flying School, Helicopter Wing, at Shawbury, Salop. This unit operates Whirlwind HAR Mk 10s and Westland/Aérospatiale Gazelle HT Mk 2s for the training task, and maintains a detachment of Whirlwinds at Valley, Anglesey, for training in SAR and mountain rescue duties.

Overseas, the RAF operates the Westland Wessex HC Mk 2 with No 18 Squadron in Germany (see "RAF Germany") and with No 28 Squadron at Kai Tak, Hong Kong, and the Westland Whirlwind HAR Mk 10 with No 84 Squadron at Akrotiri and Nicosia in Cyprus, both for SAR duties and in support of the United Nations Forces there (UNFICYP).

Westland Whirlwind HAR Mk 10: Used by CFS at Shawbury for training, and for SAR in the UK by No 22 Squadron at Brawdy, Chivenor, Coltishall and Valley, and by No 202 Squadron at Boulmer, Leconfield, Leuchars and Lossiemouth. Also used by No 32 Squadron at Northolt in the communications rôle (designated HC Mk 10) and by No 84 Squadron at Akrotiri, Cyprus, for SAR duties and at Nicosia, Cyprus, for UNFICYP duties.

Westland/Aérospatiale Gazelle HT Mk 3: Used by CFS at Shawbury for training.

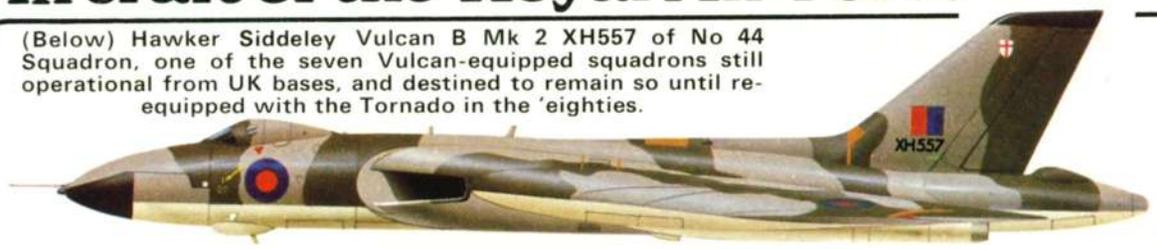
Westland Wessex HC Mk 2: Used for tactical support by No 18 Squadron at Gutersloh, Germany, by No 72 Squadron and the OCU (No 240) at Odiham, Hants, in the UK, and by No 28 Squadron at Kai Tak, Hong Kong. "D" Flight, 72 Squadron, uses this type at Manston on the SAR task and additional two-aircraft SAR units are to replace Whirlwinds at Leuchars and Valley in July and October 1976 respectively.

Westland Wessex HCC Mk 4: Two examples of this VIP version of the Wessex are used by the Queen's Flight at RAF Benson, Oxon.

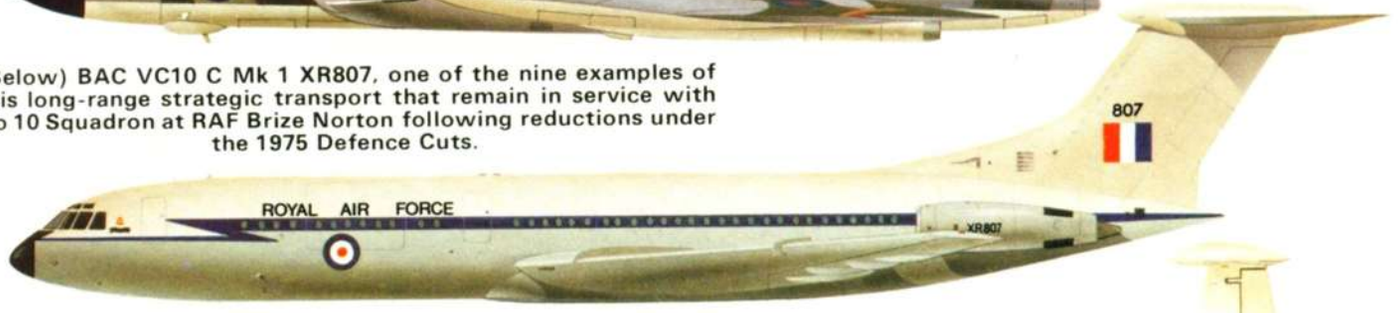
Westland/Aérospatiale Puma HC 1: Based at Odiham, Hants, this type is used by Nos 33 and 230 Squadrons and by the tactical support OCU (No 240), also at Odiham.

Aircraft of the Royal Air Force

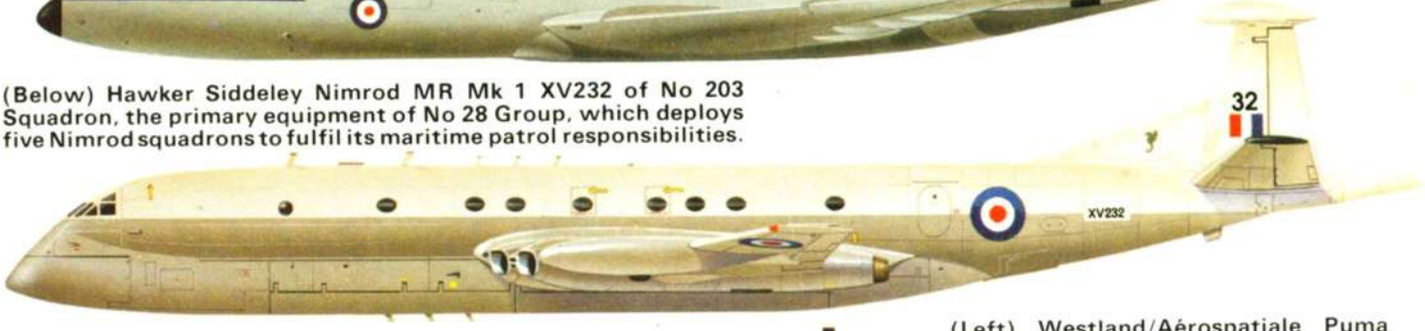
(Below) Hawker Siddeley Vulcan B Mk 2 XH557 of No 44 Squadron, one of the seven Vulcan-equipped squadrons still operational from UK bases, and destined to remain so until re-equipped with the Tornado in the 'eighties.



(Below) BAC VC10 C Mk 1 XR807, one of the nine examples of this long-range strategic transport that remain in service with No 10 Squadron at RAF Brize Norton following reductions under the 1975 Defence Cuts.



(Below) Hawker Siddeley Nimrod MR Mk 1 XV232 of No 203 Squadron, the primary equipment of No 28 Group, which deploys five Nimrod squadrons to fulfil its maritime patrol responsibilities.

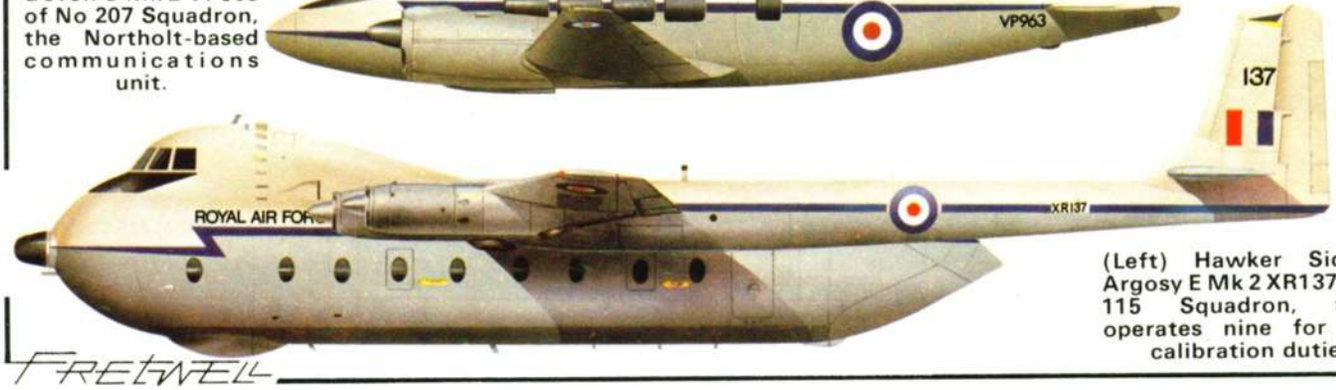


(Left) Westland/Aérospatiale Puma HC Mk 1 XW229 of No 230 Squadron, one of the two units flying this tactical support helicopter from RAF Odiham, the headquarters of No 38 Group.

(Right) Hawker Siddeley Dominie T Mk 1 XS728 as operated by 6 FTS at RAF Finningley to train rear crews. Of similar appearance are the HS 125s operated on communications duties by No 32 Squadron from Northolt, comprising four Srs 400s and two Srs 600s.

(Left) Westland Wessex HC Mk 2 XR527 of No 28 Squadron, based at Kai Tak, Hong Kong. One Wessex squadron, No 18, operates in Germany and another in the UK, No 72, operates in 38 Group and provides detachments for SAR duties at three sites.

(Right) De Havilland Devon C Mk 2 VP963 of No 207 Squadron, the Northolt-based communications unit.



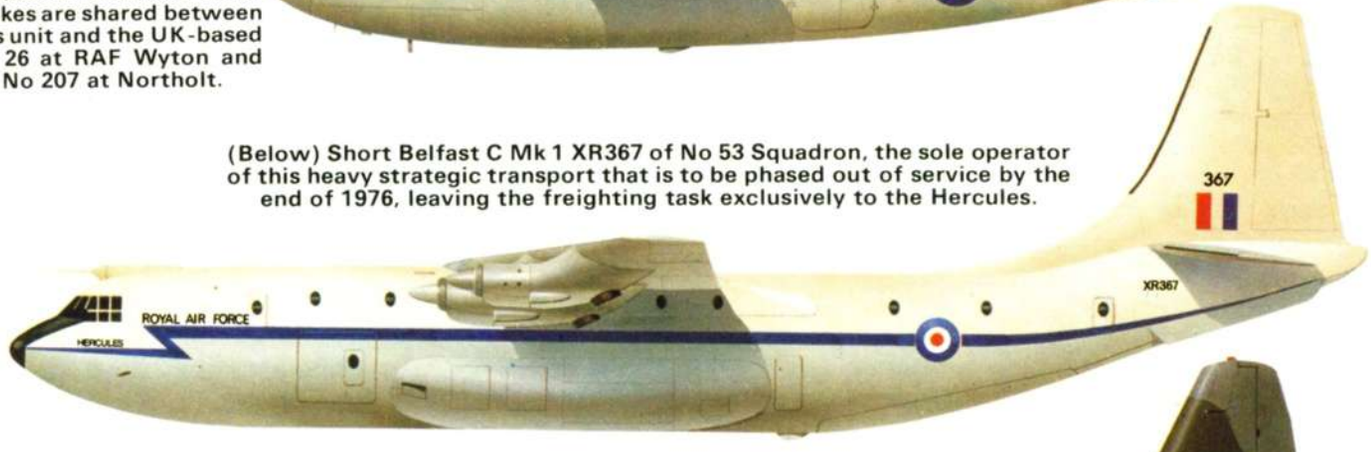
(Left) Hawker Siddeley Argosy E Mk 2 XR137 of No 115 Squadron, which operates nine for radio calibration duties.

FREEWELL

(Below) Hawker Siddeley Andover CC Mk 2 XS789 in the colours of the Queen's Flight, based at RAF Benson. The Andover C Mk 1 rear-loading transport has been retired but one or two are still serving for Casevac duties, plus a small number of C Mk 2s used for communications flights by No 32 Squadron based at Northolt.

(Right) BAC Pembroke C Mk 1 WV733 of No 60 Squadron, the Germany-based communications squadron. Fourteen Pembrokes are shared between this unit and the UK-based No 26 at RAF Wyton and No 207 at Northolt.

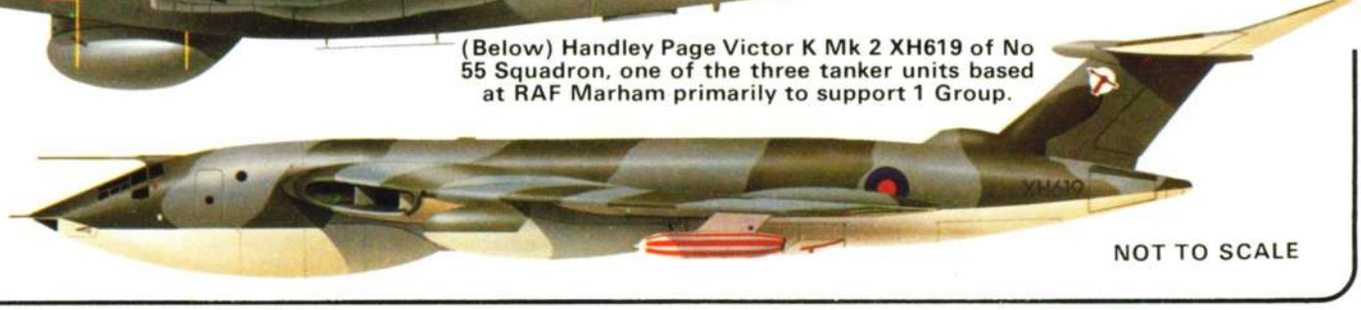
(Below) Short Belfast C Mk 1 XR367 of No 53 Squadron, the sole operator of this heavy strategic transport that is to be phased out of service by the end of 1976, leaving the freighting task exclusively to the Hercules.



(Below) Lockheed Hercules C Mk 1 XV305, one of the first to be repainted in new camouflage colours for operations within the NATO area. As an economy measure, the Hercules force has been reduced to four squadrons, Nos 24, 30, 47 and 70, sharing 48 Hercules at RAF Lyneham.

(Below) Hawker Siddeley Shackleton AEW Mk 2 WR960 of No 8 Squadron, the sole squadron committed to operating in the airborne early warning rôle.

(Below) Handley Page Victor K Mk 2 XH619 of No 55 Squadron, one of the three tanker units based at RAF Marham primarily to support 1 Group.



NOT TO SCALE

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bought and 61 remain. As originally constituted, there was a wing of four squadrons in the UK (two at Lyneham and two at Fairford), one squadron at Singapore and one in Cyprus. However, when the two squadrons overseas returned home a wing of six Hercules squadrons at Lyneham (Fairford having been relinquished some years ago) was clearly more than needed so this force has been reduced to 47 aircraft and two of the squadrons have been disbanded. These Hercules should provide for all the tactical transport needs of the RAF in Europe together with support for the ACE Mobile Force; the other overseas commitment which was originally on the Hercules order book, support of the UK Joint Airborne Task Force, has also been cut by the White Paper. The Hercules, too, will take on many of the tasks previously covered by the single squadron of Hawker Siddeley Andovers which was disbanded last year. Most of the Andovers have been placed in storage pending possible sale, although there is use for one or two of the C Mk 1s on miscellaneous duties — for example a couple now serve with No 32 Squadron at Northolt for communications duties; the Andover has previously been much used for casevac work and presumably these aircraft will continue in this rôle. In the communications field, the principal cut has been the axing of the airfield at Andover where flying ceased in January with the consequent disbanding of its resident communications squadron. Andover is also the HQ of RAF Support Command but following the merger between Support and Training Commands proposed as an additional economy measure, the HQ will move to RAF Brampton.

Another field in which the RAF has applied much effort to economise is in Training Command. Before last year's defence cuts, the RAF had already been working on rationalisation and the process has now been taken further to absorb a large amount of the mandatory cuts. Quite

McDonnell Douglas Phantom FGR Mk 2 Cutaway Drawing Key

1 Hinged radome
2 Radar antenna
3 Antenna mounting
4 Radome lock bolts
5 Emergency landing gear system air bottles
6 Radar package
7 Windscreen rain removal nozzle
8 Emergency brake air bottle
9 Windscreen
10 Optical display unit
11 Forward control stick
12 Manual ejection seat separation handle
13 Instrument panel shroud
14 Push rod
15 Control stick base
16 Rudder pedals
17 Nosewheel drag brace assembly
18 Temperature control assembly
19 Refrigeration unit
20 Nosewheel trunnion
21 Nosewheel command potentiometer
22 Ram air inlet duct
23 Approach/taxi lights
24 Nosewheel leg fairing
25 Torque arm assembly
26 Twin rearward-retracting nosewheels
27 Nosewheel steering power unit
28 Shock strut
29 Retractable steps
30 Entry hand/footholds
31 Seat pan
32 Pilot's ejection seat
33 Pilot's starboard control console
34 Remote rocket initiator
35 Canopy actuating cylinder
36 Face screen handles
37 Variable inlet duct ramp
38 Starboard intake
39 Inflight refuelling probe nozzle
40 Inflight refuelling probe (extended)
41 Support arm
42 Bleed air louvres
43 Aft cockpit canopy
44 Canopy actuating cylinder
45 Aft cockpit starboard console (Inertial Nav/Attack System)
46 Inter-cockpit fixed section window
47 Aft ejection seat
48 Aft control stick
49 Electrical equipment rack
50 Bellcrank
51 Fixed ramp
52 Perforated ramp
53 Boundary air bleed vent
54 Intake
55 Ramp actuator
56 LOX converter
57 Aft solid ramp
58 Flight director computer
59 Bleed air louvre assembly (lower)
60 Air data computer
61 Intake duct
62 Bleed air louvre assembly (upper)
63 Hydraulic reservoir
64 Air bottles (canopy/emergency flap)
65 Stabilator control cable linkage
66 Radio receiver/lead computing gyro and amplifier
67 IFF antenna

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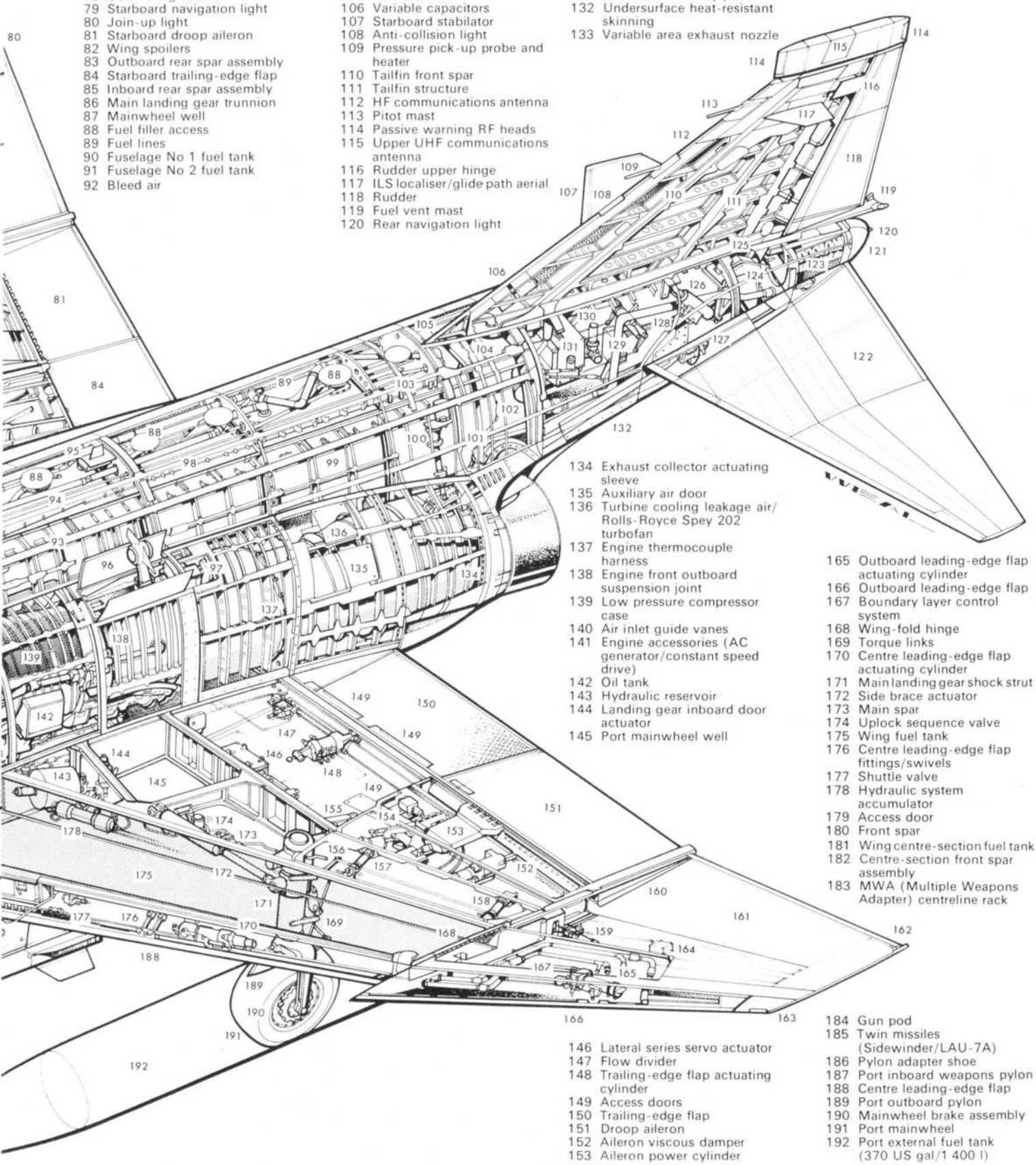


68 Wing forward structure (integral fuel)
69 Boundary layer control system
70 Starboard external fuel tank
71 Wing rib assembly (main landing gear support)
72 Front spar
73 Outboard pylon hardpoint
74 Main spar
75 Wing-fold hinge
76 Access doors
77 Outboard leading-edge flap
78 Outer wing section
79 Starboard navigation light
80 Join-up light
81 Starboard droop aileron
82 Wing spoilers
83 Outboard rear spar assembly
84 Starboard trailing-edge flap
85 Inboard rear spar assembly
86 Main landing gear trunnion
87 Mainwheel well
88 Fuel filler access
89 Fuel lines
90 Fuselage No 1 fuel tank
91 Fuselage No 2 fuel tank
92 Bleed air
93 Fuselage structure
94 Fuselage No 3 fuel tank
95 TACAN antenna
96 Ram air turbine (extended)
97 Emergency generator
98 Fuselage No 4 fuel tank
99 Fuselage No 5 fuel tank
100 Arresting gear actuator
101 Overheat detection sensing element
102 Stabilator bellows assembly
103 Fuselage No 6 fuel tank
104 Fuselage No 7 fuel tank
105 Ram air inlet
106 Variable capacitors
107 Starboard stabilator
108 Anti-collision light
109 Pressure pick-up probe and heater
110 Tailfin front spar
111 Tailfin structure
112 HF communications antenna
113 Pitot mast
114 Passive warning RF heads
115 Upper UHF communications antenna
116 Rudder upper hinge
117 ILS localiser/glide path aerial
118 Rudder
119 Fuel vent mast
120 Rear navigation light
121 Drag chute door (tail cone)
122 Stabilator
123 Drag chute housing
124 Stabilator hinge
125 Rudder control cylinder
126 Stabilator power control cylinder
127 Arresting hook uplatch mechanism
128 Cooling duct
129 Force link bellcrank
130 Stabilator feel trim system actuator
131 Trim actuator relay panel
132 Undersurface heat-resistant skinning
133 Variable area exhaust nozzle
134 Exhaust collector actuating sleeve
135 Auxiliary air door
136 Turbine cooling leakage air/ Rolls-Royce Spey 202 turbofan
137 Engine thermocouple harness
138 Engine front outboard suspension joint
139 Low pressure compressor case
140 Air inlet guide vanes
141 Engine accessories (AC generator/constant speed drive)
142 Oil tank
143 Hydraulic reservoir
144 Landing gear inboard door actuator
145 Port mainwheel well
146 Lateral series servo actuator
147 Flow divider
148 Trailing-edge flap actuating cylinder
149 Access doors
150 Trailing-edge flap
151 Droop aileron
152 Aileron viscous damper
153 Aileron power cylinder
154 Dual servo spoiler valve
155 Droop aileron actuating cylinder
156 Hydraulic line (to wing-fold system)
157 Inboard spoiler cylinder
158 Outboard spoiler cylinder
159 Wing-fold actuating cylinder
160 Wing-fold line
161 Wing outer section
162 Join-up light
163 Port navigation light
164 Compass transmitter
165 Outboard leading-edge flap actuating cylinder
166 Outboard leading-edge flap
167 Boundary layer control system
168 Wing-fold hinge
169 Torque links
170 Centre leading-edge flap actuating cylinder
171 Main landing gear shock strut
172 Side brace actuator
173 Main spar
174 Uplock sequence valve
175 Wing fuel tank
176 Centre leading-edge flap fittings/swivels
177 Shuttle valve
178 Hydraulic system accumulator
179 Access door
180 Front spar
181 Wing centre-section fuel tank
182 Centre-section front spar assembly
183 MWA (Multiple Weapons Adapter) centreline rack
184 Gun pod
185 Twin missiles (Sidewinder/LAU-7A)
186 Pylon adapter shoe
187 Port inboard weapons pylon
188 Centre leading-edge flap
189 Port outboard pylon
190 Mainwheel brake assembly
191 Port mainwheel
192 Port external fuel tank (370 US gal/1 400 l)

(Left) Westland/Aérospatiale Puma HC Mk 1 helicopters were among the RAF types that flew to Belize at the end of 1975, an aircraft of No 33 Squadron here being seen flying over the Belize jungle. (Right) A Scottish Aviation Bulldog T Mk 1 of the type now replacing Chipmunks at No 2 FTS and the University Air Squadrons. (Below left) A Westland/Aérospatiale Gazelle HT Mk 3 from the CFS at Shawbury.

TRANSPORT

No 38 Group, Strike Command, controls the transport element of the RAF and this has recently taken the largest cuts of all the flying side of the RAF, due to the elimination of most of Britain's overseas commitments. Apart from aircraft for short-range duties, it comprises 67 aircraft of three main types, using only two bases.

BAC VC10 C Mk 1: The VC10 force has been reduced to nine aircraft operated by No 10 Squadron at Brize Norton, Wiltshire.

Short Belfast C Mk 1: Ten of these aircraft are operated by No 53 Squadron from Brize Norton but are to be phased out in November.

Lockheed Hercules C Mk 1: This force, committed to tactical as well as strategic transport duties, has been reduced from six squadrons to four, Nos 24, 30, 47 and 70, all based at Lyneham, Wiltshire, where they have been joined by No 242 OCU, previously based at Thorney Island (now closed). These units operate 48 of the 61 Hercules maintained in Strike Command's inventory.

Short-range communications are carried out by three UK squadrons and one in Germany (No 60 see "RAF Germany") and these units use Pembrokes, Devons, HS 125s and Whirlwind HC Mk 10s, together with one or two Andovers and a couple of Jet Provosts.

BAC Pembroke C Mk 1: Fourteen of these aircraft are operated by No 26 Squadron at Wyton, No 207 at Northolt and No 60 in Germany.

DH Devon C Mk 2: A small number are operated by No 26 Squadron at Wyton, No 207 at Northolt with a detachment at Turnhouse, Scotland, and No 60 in Germany.

Hawker Siddeley HS.125-400 and -600: No 32 Squadron at Northolt operates four Srs 400s and two 600s on behalf of the RAF and the RN.

Hawker Siddeley Andover C Mk 1 and Mk 2: A small number of Andovers are on No 32 Squadron's charge at Northolt. The CC Mk 2 version is used by the Queen's Flight at Benson.

Westland Whirlwind HC Mk 10: Operated by No 32 Squadron (see "Helicopters").

BAC Jet Provost T Mk 3: Two of these aircraft are used by No 26 Squadron at Wyton for communications duties.

HS Argosy E Mk 1: Nine of these ex-transport aircraft are flown by No 115 Squadron, Strike Command, for radio and radar calibration duties. They are based at Brize Norton and have taken over the duties of the Canberra E Mk 15s of No 98 Squadron, which disbanded in February.

fortuitously, the RAF had arrived at a position where its requirement for twin-engined pilot training was lapsing and probably would not be required for a year or two. This coincided with the phasing-out of the Vickers Varsity after 25 years of RAF service. Accordingly, the twin school at Oakington was closed down and the Varsity replacement, the Scottish Aviation Jetstream, placed in storage. Such twin training as is necessary is at present being given through the civil school at Hamble which is also in the doldrums and can use the work.

The other large user of the Vickers Varsity has been the school at Finningley where all aircrew other than pilots receive their training. This school had been using three types — Varsity, Jet Provost and Dominie — and it had been intended to replace the Varsity, which was retired in March, with the Hawker Siddeley Argosy T Mk 2s, work on the conversion of four of these retired transports having been put in hand at HSA Bitteswell. However, this plan has been cancelled and "rear crew" training is now conducted on a two-type basis with considerably more training being carried out on the ground in simulators. After gaining air experience in Bulldogs, the rear crews train on Dominies, with additional training being given on Jet Provosts to high speed navigators (for Phantoms, Tornados, etc). In all cases, simulators play a much increased part in the training, and a trial scheme is currently being run at Coningsby to see how effectively this philosophy can be applied to the final operational conversion of crews.

One of the largest of the training units, and one of the most respected of all RAF units (as old as the first operational squadrons) is the Central Flying School at Little Rissington, Glos, with a helicopter detachment at Tern Hill which trains all the RAF helicopter pilots. This unit is now being dispersed around the RAF in the interests of economy, the Jet Provost element going to the RAF College at Cranwell, Lincs, the Gnat element to Valley, Anglesey, and the Bulldog element to Leeming, Yorks, whilst the helicopters will move in with the Central ATC School at Shawbury. What effect this will have on the entity of a famous unit remains to be seen and it may be that the CFS will be one of the units to suffer a loss of identity as a result of the cuts.

Of the helicopter force there is little change. All the RAF home units remain uncut, although the tasks of the tactical helicopters, the Pumas and Wessex's based on Odiham, are to be rationalised in a more flexible way. Overseas, the one remaining squadron at Singapore with Wessex's has been disbanded, but the other two overseas units, in Cyprus and Hong Kong, are still operating. There is even promise of new helicopters, Sea Kings, for the two Search and Rescue squadrons in the UK to supplement, from late 1977, the Whirlwinds they already use, and meanwhile Wessex's returned from Singapore are being converted to take over

The Hawker Siddeley Hawk T Mk 1 will be phased into service as the RAF's newest trainer in the course of 1977, at the CFS and No 4 FTS.

TRAINING

A large reshuffle of the flying training units of the RAF has been taking place over the last year or two and is now almost complete, the only complications caused by the additional cuts of the 1975 Defence Review being the closures of Little Rissington and Tern Hill, involving the moving of CFS to four separate bases, and the cancellation of the Argosy T Mk 2 as crew trainers for No 6 FTS, resulting in the increased use of simulator training. The next stage in updating Training Command will be the introduction of the Hawker Siddeley Hawk T Mk 1 in 1977. The 1976 Training Command scene involves four Flying Training Schools, the RAF College, the Central Flying School (CFS), the Central Air Traffic Control School (CATCS), 16 University Air Squadrons (UAS) and the Air Experience Flights (AEF). These units use the following types of aircraft:

BAC Jet Provost T Mk 3A: New equipment installed in the Jet Provost T Mk 3 has accounted for the introduction of this redesignated variant at Cranwell for the RAF College (and CFS) and at Linton-on-Ouse where it is used by No 1 FTS.

BAC Jet Provost T Mk 4: This version is still in use with No 6 FTS at Finningley for navigation training and at the CATCS at Shawbury.

BAC Jet Provost T Mk 5 and T Mk 5A: These versions (the latter with updated radio equipment as in the T Mk 3A) are the standard pilot training aircraft, in use at No 1 FTS, Linton-on-Ouse, and at the RAF College/CFS at Cranwell.

DHC Chipmunk T Mk 10: This type continues in service with the AEFs around the country to give air experience to cadets of the ATC and CCF.

HS Gnat T Mk 1: Almost all the RAF's Gnats are now based at Valley in Anglesey where they are extensively used by No 4 FTS for advanced jet pilot training. The CFS Gnats have joined them there, only the Red Arrows team remaining at Kemble, Glos.

HS Hunter F Mk 6 and T Mk 7: These are used also by No 4 FTS at Valley.

HS Dominie T Mk 1: This type is extensively used by No 6 FTS at Finningley, Yorkshire, for training rear crews (Navigator, AEO, Engineer) and by the RAF College/CFS at Cranwell, Lincolnshire.

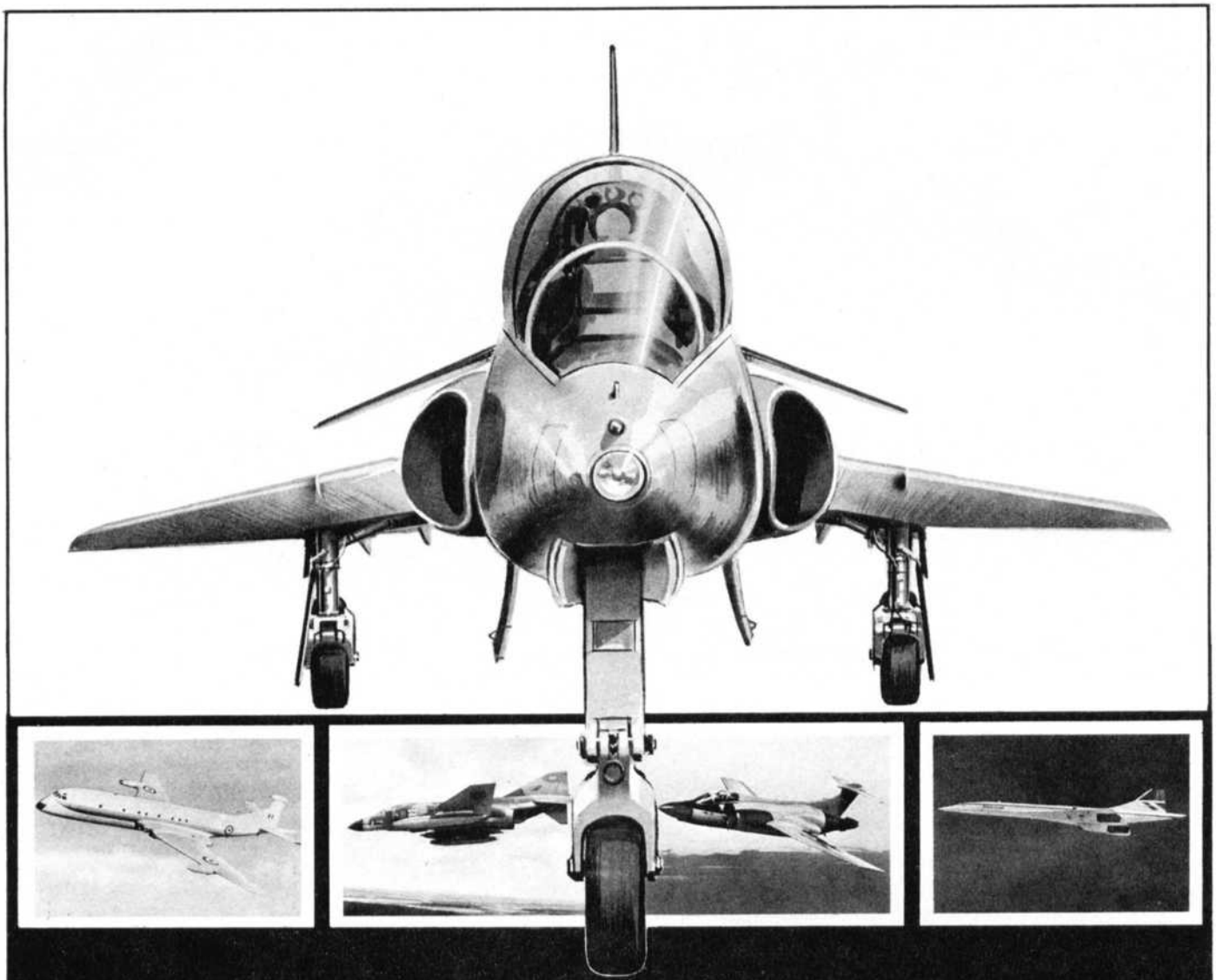
Hawker Siddeley Hawk T Mk 1: This new type, intended to replace the Gnat and Hunter in Training Command, is due to enter service with CFS at the end of this year or early 1977, and with No 4 FTS, Valley, later next year.

Scottish Aviation Bulldog T Mk 1: This type has been introduced into Training Command over the last year or two and now completely equips No 2 FTS at Leeming, Yorkshire, where it serves the Primary Flying Squadron and also gives all RN helicopter pilots initial fixed-wing experience. The CFS Bulldog unit has also moved to Leeming from Little Rissington, and this type is used by the 16 University Air Squadrons throughout the country.

SAR duties from Whirlwinds at two sites in the UK in addition to Manston, where two of this type already operate in this rôle.

This, then, is how the RAF has shaped up to the conflict in which it is currently engaged with economic and political forces. The Royal Air Force in 1976 is slimmer than it has been for some 40 years, but the lean are usually healthier and more agile than the corpulent. Certainly, the shedding of a little weight, albeit *not* excess fat, has not impaired the operational side of the Service, and the standard of training and professionalism has not been lowered one whit. And this is all to the good for, like it or not, Britain's very future existence, not simply freedom and happiness, may one day again depend on the existence of a healthy, operationally capable Royal Air Force. □

Responsible for "flying the flag" for the RAF and Britain all over the world, the Red Arrows aerobatic team — seen here over the Severn Bridge — will continue to use Gnats at least until the end of the 1977 season.



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NATO AIR IN EUROPE

John Fricker reviews the organisation and equipment of the air components of the 15 North Atlantic Treaty Organisation nations

IN THE 27 years of its existence, from 4 April 1949 onwards, the North Atlantic Treaty Organisation has undergone many changes and withstood many strains. It has been fragmented by the departure, in 1966, of France from its military organisation followed more recently by the forces of Greece; there is current dissension between several of its members — notably Greece and Turkey, Turkey and the US, and the UK and Iceland, while Portugal must now be reckoned a dubious asset in an avowedly anti-Communist alliance. It has been described as "weakening fast, both in resolve and in hardware", and is now admittedly technically outclassed in many types of war material as well as substantially outnumbered by the forces of the opposing Warsaw Pact.

On the occasion of NATO's 25th anniversary in 1974, Secretary-General Dr Joseph Luns underlined the Organisation's problems when he admitted that he saw "no possibility of a meaningful European defence . . . The countries of Western Europe, some more, some less, are disinclined to spend the necessary proportion of their gross national product on defence . . . The dependence on the US will continue for a long time . . . The not unimportant British and French nuclear forces, which are in a real sense a force of dissuasion, are too weak to take the place of the great deterrent of the US strategic nuclear forces . . ."

And yet on the same occasion, Dr Luns also said: "The differences and disappointments inside NATO of the last few years are over. We have found a new sense of solidarity which the Russians cannot ignore. The clouds have begun to recede and the way is open for progress on détente between East and West." His remarks were echoed by the Ottawa declaration, issued on NATO's 25th anniversary, which stated, among other things, that "the members of the alliance reaffirm their conviction that the North Atlantic Treaty provides the indispensable basis for their security, thus making possible pursuit of the détente".

Equally important, in the declaration, was the following commitment: "The European members who provide three-quarters of the conventional strength of the alliance in Europe, and two of whom possess nuclear forces capable of playing a deterrent rôle of their own contributing to the overall strengthening of the deterrence of the alliance, undertake to make the necessary contribution to maintain the common defence at a level capable of deterring and, if necessary, repelling all actions directed against the independence and territorial integrity of the members of the alliance."

Despite its shortcomings, therefore, it appears that NATO is here to stay, although following its success in staving off the external threat from the East, one of the main problems is now likely to prove the countering of internal dissension. This implies a continuation of the change in tactics which resulted in May 1967, from abandonment of the former fundamental NATO strategy of immediate massive retaliation by nuclear weapons in the event of Soviet aggression against any member country of the alliance, to the doctrine of flexible response. Massive retaliation, also known as the nuclear tripwire policy, evolved from the original strategic supremacy of the US in atomic weapons and their delivery systems, and became obsolete with the achievement of nuclear parity by the Soviet Union. Its inherent inflexibility was summarised by President Kennedy, when still a Senator, who said: "We have driven ourselves into a corner where the only choice is all or nothing at all — world devastation or submission."

Flexible response, on the other hand, while not ruling out the use of atomic weapons, means that NATO must be prepared to meet an attack of any kind at any level before resorting to graduated nuclear escalation. A graduated response, it is felt, would allow the alliance time to assess the size and nature of an attack, plus the intentions behind it, while providing effective resistance initially with conventional weapons. Whether escalation could be contained once even the smallest tactical atomic weapon is employed is arguable, but adoption of the flexible response doctrine and its concomitant planning for a more prolonged campaign, also placed considerably greater emphasis on the development and consolidation of conventionally-armed ground and air forces.

Unfortunately, while flexible response has evidently decreased the probability of nuclear war in Europe, there is a growing tendency within many countries of the alliance — especially on the flanks — to conclude that conventional forces may therefore be reduced. An objective study must show that this is a mistake, particularly in view of the continued increase in strength of the opposing Warsaw Pact forces, but for largely doctrinaire reasons, such a policy is currently and regrettably being pursued by the governments of Denmark and the Netherlands, among others in the alliance.

Force Discrepancies

Even with the present disparity between NATO, with its 780,000 troops, and the 950,000-strong Warsaw Pact forces in Europe, the point cannot be too far off where further reductions in conventional forces would result in effective resistance no longer being credible.

The McDonnell Douglas F-4 is used by five of NATO's fifteen nations, including the UK, Greece and Turkey as well as the USA and Federal Germany. Illustrated are an F-4E of the 32nd Tactical Fighter Squadron, USAFE, at Soesterberg, Netherlands, and an RF-4E of the Luftwaffe's Aufklärungsgeschwader 51 "Immelman" at Bremgarten in 4 ATAF.

As the balance of military power slips further in favour of the Communist bloc, the means of political pressure on Western Europe open to the Soviet Union will correspondingly increase.

In the most recent assessment of comparative strengths towards the end of last year, the chairman of the Military Committee of the alliance, Admiral Sir Peter Hill-Norton, RN, while confirming Warsaw Pact numerical superiority over NATO of more than two to one in army divisions, aircraft and artillery and three to one in tanks, said that there had also been a steady and continuous improvement in both quality and quantity of weapons, equipment and training in the Communist forces, with growing emphasis on offensive capabilities. "In the 1960s," he added, "NATO had held a clear lead in the quality of its aircraft and still had the potential to retain this, but at present the Soviets have caught up in technology and are even ahead in some respects." By the 1980s, predicted Admiral Hill-Norton, most of the Soviet and Warsaw Pact aircraft will be of advanced design, using the latest electronic devices and with improved range and weapons.

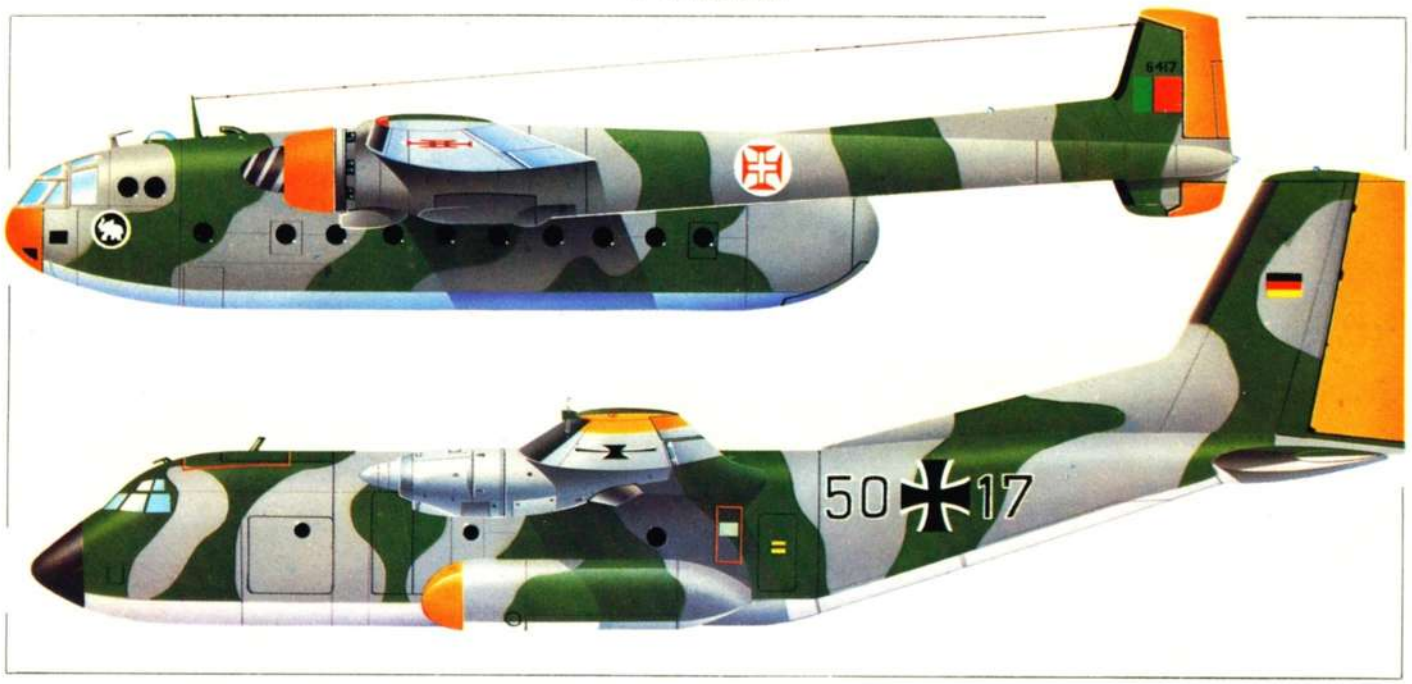
The large increase in Communist air strength in Europe, he continued, was reflected in the introduction of tactical aircraft with deep penetration capability. The Admiral was referring in particular, according to the NATO Military Committee, to the Sukhoi Su-17 *Fitter-C* now operational with SovAF and Warsaw Pact ground attack regiments, as well as the first Sukhoi Su-19 *Fencers*, also of variable-geometry design, permitting deep penetration over ranges of up to 2,400 miles (3 860 km) and strike missions against NATO from Soviet territory.

There was also, said Admiral Hill-Norton, a clear trend for more fighter aircraft to be available for offensive ground attack ahead of the Warsaw Pact armies. The Military Committee confirmed that "significant numbers" of MiG-23 *Flogger* single-seat variable-geometry fighters in both air defence and ground attack versions have now been deployed with the SovAF. The Mach 3·0 MiG-25 *Foxbat* is also operational in the forward area, flying long-range tactical reconnaissance missions at very high altitudes. The SovAF is increasing its training, in addition, in the ground support and battlefield attack rôles. From its former mainly defensive posture, the SovAF has also changed over the past two or three years to dual-rôle capability, with a 200 per cent increase in payload potential for conventional ground-attack missions.

Although NATO air forces rely heavily upon US aircraft, attempts to standardise equipment have had little success. Among the oldest types still operational is the North American F-100D Super Sabre, the example shown serving with 730 Eskadrille of Denmark's Flyvevaben at Skrydstrup; one of the newest types is the Dassault-Breguet Mirage 5BA, as represented here by an aircraft of No 2 Squadron, Force Aérienne Belge, based at Florennes.

(Above) Canada's contribution to NATO air power, concentrated in AFCENT, now comprises three squadrons of CF-104 Starfighters, of which one is dedicated to tactical reconnaissance and two to ground attack. (Below) A McDonnell Douglas F-4D of the 48th Tactical Fighter Wing based at RAF Lakenheath in the UK, newly-painted in a three-tone green finish, light green replacing the earlier earth colour.

Although the Lockheed Hercules is NATO's most used transport, both the Nord Noratlas and Transall C.160 are used in some numbers. Illustrated are a Noratlas of the Esquadra de Transportes of the Força Aérea Portuguesa and a Transall of the Luftwaffe's Flugzeugführerschule "S" at Wunstorf.



Soviet military transport is now supplemented by Aeroflot in the semi-annual task of rotating troops within the Warsaw Pact, now being achieved in about one-third the time it took in 1972. A new tactical surface-to-air missile system, known to NATO as the SA-8 and apparently deployed on an amphibious carrier, is thought to be ready for operational use. A widening deployment is also reported of armed helicopters, and about 100 Mil Mi-24 *Hinds* are believed already in service. The Tupolev *Backfire* variable-geometry strategic bomber, which is now operational, has been assessed capable of both peripheral and inter-continental missions either as a bomber or as an air-to-surface missile platform.

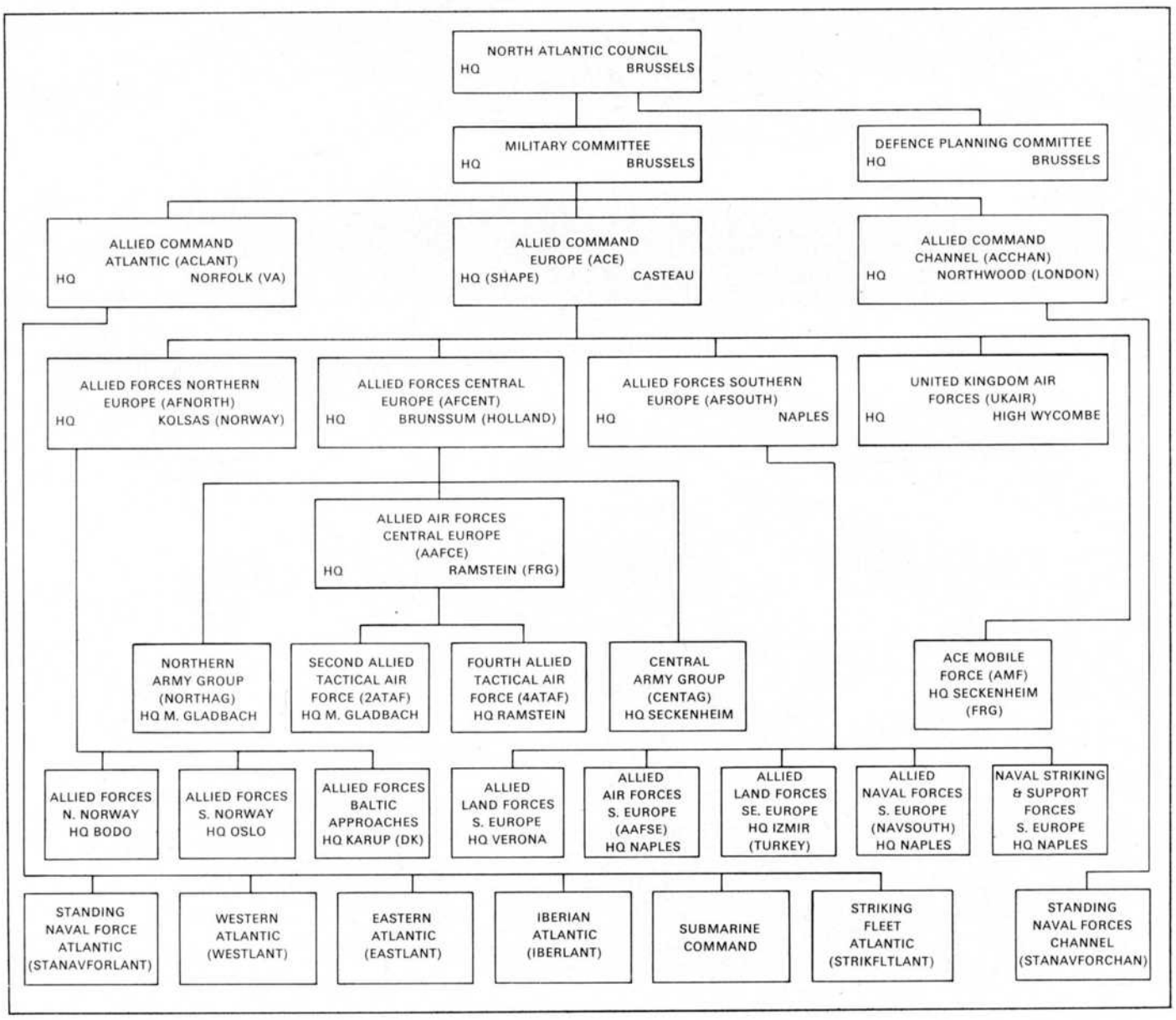
Of the 15,900 Soviet-supplied tanks in the Warsaw Pact, compared with 6,000 in NATO, most are modern 36-ton T-62s, now being supplemented by the T-72 super-tank and the M-1970 armoured personnel carrier. Over the past three years, some 3,000 APCs have been supplied to the Soviet Forces in East Germany, supplementing the Warsaw Pact inventory of some 35,000 armoured fighting vehicles, and the Soviet Union has deployed in Central Europe only about one-third of its total tank force of some 40,000. Even so, according to Admiral Hill-Norton, the Warsaw Pact combat formations located in Eastern Europe, and the three Western military districts of the Soviet Union, have increased their tank strength by more than 30 per cent in recent years.

Only in one area — that of tactical nuclear weapons — can NATO claim superiority over the Warsaw Pact forces, by virtue of some 7,000 warheads of this type stockpiled by the US in Europe, and particularly in West Germany. These atomic (fission) warheads of between 20-100 kiloton yield, which are considered by NATO planners to comprise a formidable additional deterrent against Soviet aggression, outnumber the 3,000 or so tactical nuclear weapons of the Warsaw Pact countries by more than two to one. There are additional smaller numbers of British tactical "nukes", together with the standard French AN-52 nuclear warhead of 15 kt yield, for delivery by Jaguars or Pluton battlefield missiles, but each country maintains strict custody of its own weapons. France, of course, also insists on maintaining rigid political and military independence for all its nuclear forces.

In the case of the US "nukes", however, these are scheduled for delivery in the event of hostilities by some 2,000 primary systems, including aircraft, surface-to-surface missiles, artillery and even mines, distributed throughout the NATO alliance except for Luxembourg. In all, NATO has around 2,900 tactical aircraft with either nuclear-strike or conventional ground attack rôles. Many have additional intercept capability, and nearly all must be considered as having a nuclear potential. Opposing them are at least 4,200 combat aircraft operated by 208,000 Warsaw Pact personnel in Central Europe alone, and with equal nuclear delivery potential.

In addition to aircraft, missiles, artillery and howitzers as delivery systems, NATO nuclear thinking now extends to the use of European atomic minefields, known as Atomic Demolition Munitions (ADMs), which would be set off in "friendly" areas before or during the arrival of the enemy to cause enormous craters and create unsafe radiation zones. Selected ADM areas reportedly include West Germany, Italy, and Turkey, although enthusiasm for use of these weapons apparently comes mainly from the US. NATO planners are also considering the use of low-yield, high-radiation "mini-nukes", delivered by means

MAIN NATO MILITARY ORGANISATION



The Northrop F-5 Freedom Fighter serves with four NATO air forces — those of Norway, Turkey and Greece in addition to the Dutch Koninklijke Luchtmacht; four NF-5As of the latter's Nr 315 Tactical Fighter Squadron at Twenthe are illustrated.

of smart bombs with laser guidance. In recent MBFR (Mutual Balance Force Reductions) negotiations, however, the US has proposed withdrawing 1,000 tactical nuclear weapons and 29,000 troops from Central Europe, in return for the Soviet Union pulling-out a tank army of 1,700 armoured vehicles and 65,000 men.

Command Structure

Europe is the focal point of World politics and despite the limited conflicts elswhere, it is generally considered that, as in the past, any major war will inevitably begin on the Continent. The military headquarters of NATO — SHAPE (Supreme HQ of Allied Powers in Europe) — is therefore in Europe at Casteau, near Mons, in Belgium, and Allied Command Europe (ACE) is responsible for the defence of all NATO territory on the Continent, between the northern tip of Norway and the Eastern boundaries of Turkey, except for Britain, France, Iceland and Portugal. The Supreme Allied Commander Europe (SACEUR), is also Commander-in-Chief of the US Forces in Europe and is therefore always an American Officer.

NATO, however, has two other Commands of equal significance. As the sole American-based formation, Allied Command Atlantic (ACLANT) has its HQ in Norfolk, Virginia, and covers the oceans of the northern Atlantic between the Pole and the Tropic of Cancer, and the North American and European seaboards. Apart from a small standing naval force (STANAVFORLANT) of four destroyers, the Supreme Commander (SACLANT) — an American Admiral — has no peacetime units specifically assigned, but co-ordinates training through frequent exercises of mainly maritime forces from Britain, Canada, Denmark, Germany, the Netherlands and the US. Nucleus of the Striking Fleet Atlantic is the US 2nd Fleet with four attack carriers, whose aircraft share the nuclear strike rôle with missile-firing submarines. RAF Strike Command also contributes a squadron of 12 Martel-armed Buccaneer S Mk 2Bs assigned from Honington, while other of its Buccaneers, together with its Vulcan strategic bombers and photographic-reconnaissance Canberras, are earmarked for assignment to SACEUR.

Third major NATO command — Allied Command Channel (ACCHAN) — has the wartime task of controlling the English Channel and the Southern North Sea. Its HQ are at Northwood, near London, and it is commanded by a British Admiral (CINCHAN). Once again, it has no assigned forces, apart from a small group of mine counter-measures ships, but many of the smaller naval vessels and some maritime patrol aircraft of Britain, Belgium, Germany and the Netherlands are earmarked for wartime control by SACLANT. The Maritime Air Commander Channel Command is the ÂOC of No 18 (Maritime) Group of the RAF, who also wears a third hat as Maritime Air Commander Eastern Atlantic within ACLANT, and all four of his squadrons with most of the 46 Nimrod ASW patrollers delivered to the RAF to date are assigned to the alliance.

As the heart of NATO, Allied Command Europe (ACE) controls all 2,900 tactical aircraft on about 220 airfields of standard layout, backed by a common infrastructure of storage depots, fuel pipelines and communications. Most of the land and air forces within the Command are assigned to NATO, whereas the naval forces are merely earmarked. Apart from the NATO Air Defence Ground Environment System (NADGE), SACEUR does not normally command allied forces until certain levels of alert, previously agreed with national authorities, are reached. The Supreme Commander would, if such a contingency arose, assume overall control of the national forces committed to Allied Command Europe. In peacetime, however, SACEUR retains the right to inspect all assigned forces and evaluate their capability to complete the tasks which they would undertake in an emergency. Such evaluations (TACEVALs) are completed about twice a year without warning in all the component forces of ACE.

Since Allied Command Europe covers so large an area, from the frontiers of the Soviet Union with northern Norway to similar boundaries between the USSR and eastern Turkey around the Black Sea, it is sub-divided on a geographical basis into three main subordinate components. These respectively comprise Allied Forces Northern, Central and Southern Europe (AFNORTH, AFCENT and AFSOUTH), grouping assigned or earmarked ground, air and naval units of the NATO nations into joint headquarters control for wartime deployment and frequent and intensive peacetime training. Their many air force components are described in greater detail later in this account.

One other major component completes the establishment of Allied Command Europe. This is the United Kingdom Air Forces (UKAIR), with HQ at High Wycombe, Bucks, which became fully integrated with SACEUR's other European air components in 1975, when its air officer commanding was given the NATO post of Commander-in-Chief, United Kingdom Air Forces (CINCUKAIR). Strike Command is now directly within the NATO chain of command, and all its combat and support aircraft would become available for deployment by SACEUR in an emergency. Included in UKAIR is the UK Air Defence Region (UKADR) which essentially covers the RAF home-based interceptor force of No 11 Group, Strike Command, and its associated ground equipment. The UKADR, contained entirely within NATO Early Warning Area 12, forms part of the unified air defence system which extends to cover three other NATO air defence regions. Following a recent reorientation because of increased threat of low-level attack from Soviet manned aircraft, the ADR organisation now comprises three key sector operations centres with radar control and reporting facilities and fed with information from six NATO Air Defence Ground Environment stations via digital links from other centres and reporting posts.

Additional links are provided with the Ballistic Missile Early Warning System (BMEWS) station at Fylingdale, Yorks, while further long-range low-level radar cover is provided by 12 Shackleton AEW Mk 2 airborne early-warning aircraft converted from MR rôles. The Shackletons are scheduled for eventual replacement either by specially-equipped Nimrods or NATO-operated Boeing E-3A AWACS (Airborne Warning and Control System) aircraft to aid long-range interceptions by 11 Group's all-weather force of some

(Above) The Aeritalia G.91 serves with the air forces of Germany, Portugal and Italy, a G.91R being shown (top) in the markings of the 51° Stormo Caccia "Ferruccio Serafini" of the Aeronautica Militare Italiano. The lower drawing and the photo right depict a Lockheed F-104G of the Koninklijke Luchtmacht's Nr 322 Squadron, based at Leeuwarden.

(Above left) When the last Convair F-102As were withdrawn from USAFE, batches were supplied to the air forces of both Turkey and Greece, the illustration showing one of the latter's F-102As in service with the 342 Mira at Tanagra. (Below) Both Greece and Turkey also operate the Northrop F-5 Freedom Fighter, the illustrations showing an Hellenic Air Force F-5A as used by the 337, 341 and 343 Mire, and an F-5B of the Türk Hava Kuvvatleri.

84 fighters in seven squadrons, supported by Victor tankers of No 1 Group and backed by recently re-formed squadrons of BACGW Bloodhound 2 SAMs.

No 11 Group is currently re-equipping from short-range single-seat Lightnings to the more sophisticated and farther-reaching two-seat F-4M Phantom, although two RAF Lightning squadrons are expected to continue operating in the UK until at least 1980. Over the longer-term, up to nine interceptor squadrons, including two in Germany, are scheduled to re-equip with 165 air defence variants (ADV) of the Panavia Tornado, together with an OCU which will receive several dual-control trainer versions of the Tornado.

Although for strategic reasons the UK ADR is not a direct part of the NADGE chain, on which work was completed between 1967 and 1973, and now comprises 84 sites along 3,000 miles of Iron Curtain frontiers, between Norway and Turkey, its warning network meets NATO standards and is electronically interfaced with the Continental net. NADGE is a fully computerised and decentralised advanced system of radars, data-processing, display and communications equipment with considerable ECCM capability providing a standardised and integrated air defence network throughout Western Europe.

Apart from the manned interceptors of the participating countries, NADGE is backed by a highly effective surface-to-air missile belt based on the standardised use of Western Electric MIM-14B Nike-Hercules for high-level coverage (up to 100,000 ft/30 500 m or more) and Raytheon MIM-23A Hawks and MIM-23B Improved Hawks for medium and low-level use. Additional backing is provided on the Continent by the new generation of mobile low-level SAMs such as the Euromissile Roland in the French and German armies, the Thomson-CSF/MATRA R.440 Crotale of the *Armée de l'Air* and RAF Germany's newly-installed BACGW Rapiers, as well as its Bloodhound 2s.

If recent recommendations by the NATO Defence Ministers are adopted, the NATO air defence organisation is likely to be revolutionised in the 'eighties by the joint purchase of either 25 or 36 Boeing E-3A AWACS aircraft. Since ground-based radars cannot detect a target until it appears above the horizon, their effectiveness against high-speed low-flying aircraft is currently limited, but an AWACS platform at 30,000 ft (9150 m) has a look-down radar range of up to 215 nautical miles (400 km). AWACS also offers invaluable command, control and communications functions for tactical situations, and the E-3A can remain on station for up to nine hours or more without refuelling. Main problem for NATO, of course, is the procurement cost, which, at around $60m (£30m) or more per aircraft plus spares, would represent a programme investment of around $1,500m (£750m).

As the remaining element of Allied Command Europe, the ACE Mobile Force (AMF), with HQ at Seckenheim, Germany, was formed to operate under the direct control of SACEUR and reinforce such vital flank areas of NATO as northern Norway, the Baltic approaches, Turkey and Greece. Eight countries contribute seven infantry battalion groups, an armoured reconnaissance squadron, six artillery batteries, air transport and helicopter detachments, plus tactical ground-support squadrons, including 12 UK-based Harrier V/STOL fighters and a few Pumas and Wessex helicopters of No 38 Group, RAF, when required. Airlift support for the UK element of the AMF is also provided by the Hercules, Belfasts (until November) and VC10s of the RAF.

European Commands in Detail

Although located in perhaps the most vulnerable area in NATO's Allied Command Europe, the allied forces in the northern region (AFNORTH), which have their HQ at Kelsaas, Norway, and are responsible for the defence of Denmark, Norway, Schleswig-Holstein and the Baltic Approaches, are by no means the strongest. Traditionally commanded by a British general (CINCNORTH), AFNORTH is alone among the three geographical European components of ACE in having no discrete air organisation, and most of the tactical land, sea and air forces of Denmark are merely earmarked for NATO in an emergency rather than specifically assigned to it. Western Germany, however, does have assigned to AFNORTH one army division, two combat air wings of the *Marineflieger*, with F-104G Starfighters and Breguet Atlantics, and the Baltic fleet. German army aviation (the *Heeresflieger*) also contributes a battalion of 20 Dornier-built Bell Iroquois and Aérospatiale Alouette-Astazou helicopters to AFNORTH.

Under the terms of its 1973 Defence Act, Denmark is limited to 116 first-line aircraft in six operational squadrons, and persistent political opposition to nuclear weapons continues to restrict the Royal Danish Air Force *(Kongelige Danske Flyvevåben)* to conventional armament. From Karup, Air Tactical Command *(Flyvertaktisk Kommando)* exercises control of all squadrons and missile units, including three fighter-bomber, two interceptor and one fighter-reconnaissance squadrons, plus eight SAM batteries and supporting units. All combat squadrons have an establishment of 20 aircraft, with the exception of the tactical recce unit which has 16 aircraft.

Main RDAF fighter-bomber is still the North American F-100D/F Super Sabre, which equips two squadrons and will continue in service until replaced by General Dynamics' F-16 lightweight air superiority fighters towards the end of this decade. Despite the generally low priority it affords to defence, Denmark was a signatory to the NATO consortium procurement of 306 F-16s in mid-1975, and approved the purchase of an initial batch of 48 for the RDAF, plus options on a further 10. The RDAF also operates a squadron of Saab 35XD Drakens as ground-attack/interceptors, plus a second tactical-recce squadron with 20 RF-35XD Drakens.

Air defence duties in Denmark are undertaken by two squadrons of Lockheed Starfighters including 15 Canadair-built CF-104Gs and seven two-seat CF-104Ds recently purchased from Canada to supplement the remainder of 25 F-104Gs supplied under MAP in 1964. An additional Air Defence Group under Tactical Command is solely missile-armed, with four Nike-Hercules squadrons each with nine launchers, and four Hawk batteries on permanent sites around Copenhagen. Supporting transport units include a medium-lift squadron recently re-equipped from four Douglas C-54D/Gs to three Lockheed C-130H Hercules, mainly for air supply flights to Greenland, plus eight Douglas C-47 Dakotas, and an SAR helicopter squadron with eight Sikorsky S-61As.

The Royal Norwegian Air Force *(Kongelige Norske Luftforsvaret)* is divided into two Air Commands — North and South — integrated within NADGE and controlling a dozen squadrons. Seven of these units have combat capability and a total inventory of 117 first-line aircraft, including reserves. Two fighter-bomber squadrons plus an OCU with an additional combat rôle operate 60 Northrop F-5As and 13 two-seat F-5Bs, while a fourth squadron has 13 Northrop RF-5A(G)s for tactical-recce. In addition to one long-established interceptor squadron with 15 MAP-supplied Lockheed F-104Gs, the RNoAF now has a second Starfighter unit mainly for anti-ship strike duties following the purchase of 19 Canadair CF-104s and three two-seat CF-104Ds from the Canadian Government in 1974.

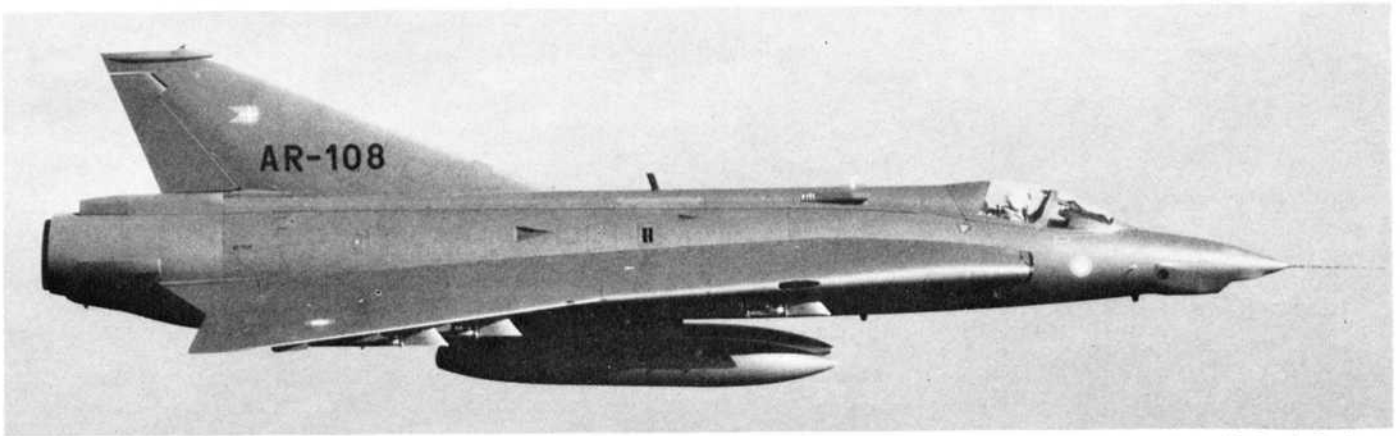
Norway's air defence system includes four batteries of Nike-Hercules SAMs around Oslo and in the east of the country, to be supplemented from 1979 onwards by the Euromissile Roland 2 for low-level coverage. In the 1980s, the RNoAF will also begin replacing the Starfighters and F-5As with the first of 72 General Dynamics' F-16 air superiority fighters ordered last year through the NATO consortium.

The remaining RNoAF combat unit, the anti-submarine squadron currently operating five Lockheed P-3Bs, may be reinforced over the next few years, according to recent Defence Ministry recommendations, by a further three Orions. Other suggested procurement included a further six helicopters to supplement the 10 Westland Sea Kings and 26 Bell UH-1B Iroquois of two SAR and army support squadrons. These supplement a transport squadron with six Lockheed C-130Hs and two Dassault Breguet Falcon 20s.

The Central European Scene

By far the largest component of ACE, with assigned forces from Belgium, Britain, Canada, West Germany, the Netherlands and the US, Allied Forces Central Europe (AFCENT) exercises joint control over about 25 NATO divisions, and more than 2,500 tactical aircraft from HQ at Brunssum in the Netherlands. Its C-in-C (CINCENT) is a general of the West German *Bundeswehr*. AFCENT is further divided into Northern and Central Army Groups (NORTHAG and CENTAG), each region with its Allied Tactical Air Force (ATAF). Since 1974, the 2nd ATAF in the North, made up of elements of the Belgian, British, Dutch and West German forces, together with 4th ATAF operating south of a line between Göttingen and Liège, with units from the *Luftwaffe* and the Canadian and US air forces, plus a US Army Air Defense Command element, have been placed under the centralised control of a revived HQ known as Allied Air Forces Central Europe (AAFCE). Located at Ramstein AFB, Southern Germany, AAFCE HQ is commanded by an American four-star general, who is also C-in-C of the USAF in Europe (USAFE).

Largest element in 2nd ATAF, together with the West German *Luftwaffe*, is RAF Germany, which shares with the NATO formation



(Above) Until the arrival of the General Dynamics F-16s, the Danish Flyvevåben's most modern equipment comprises 46 Saab Drakens of assorted versions, including 20 S 35XD reconnaissance fighters, as illustrated, used by the 729 Eskadrille at Karup. (Below left) Principal equipment of the Force Aérienne Belge comprises the Dassault-Breguet Mirage 5, a total of 106 having been acquired; a Mirage 5BR is illustrated, operated by 42 Squadron at Florennes.

a common C-in-C and peacetime HQ at Rheindahlen, near München-Gladbach, alongside the equivalent army headquarters of NORTHAG and the British Army of the Rhine (BAOR). In war conditions, at a prescribed stage in the NATO alert system, 2nd ATAF HQ would shift to Holland to exercise control of the assigned forces. Except in an emergency, these normally comprise only the defensive elements of 2nd ATAF, leaving the offensive forces to be commanded and controlled on a national basis. HQ RAF Germany is thus responsible for the operational training of assigned offensive units, together with their required engineering, administrative and logistic support.

Main NATO tasks of 2nd ATAF are defined as offensive operations, air defence, reconnaissance, support of NORTHAG and helicopter support of the First British Corps of BAOR. RAF Germany has additional national tasks resulting from the treaties of Paris and Potsdam, including its share of the tripartite responsibilities for policing Federal German air space and maintenance of access to Berlin.

For these tasks, RAF Germany currently operates 13 tactical and support squadrons distributed among four hardened operational bases, mainly along the Dutch border, together with appropriate support units. For long-range low-level penetration, two squadrons each with a dozen or so Hawker Siddeley Buccaneer S Mk 2Bs are currently being supplemented by four squadrons of the new and advanced Anglo-French SEPECAT Jaguar GR Mk 1s. In addition to their primary rôle of nuclear strike, both types of aircraft can carry conventional weapons for ground attack missions — respectively 16,000 lb (7 257 kg) and 10,000 lb (4 535 kg). The Jaguars are currently replacing smaller numbers of McDonnell Douglas F-4M Phantom FGR Mk 2s in RAF Germany's strike squadrons, and some of the Phantoms thus available for redeployment are scheduled to begin re-equipping the Command's two Lightning F Mk 2A interceptor squadrons from the end of this year onwards. An additional Phantom squadron, specialising in tactical reconnaissance, is also scheduled to re-equip with Jaguars, bringing the total number of Jaguar squadrons in RAF Germany to five.

The Lockheed Hercules is the principal transport equipment of several NATO air forces, including those of Belgium, Canada, Denmark, Italy, Greece, Norway (illustrated), Turkey, the UK and the USA.

A unique contribution to NATO forces in Central Europe is made by RAF Germany's Harrier Wing, comprising a highly mobile first-line force of 36 V/STOL ground attack fighters in three squadrons. Although nominally based together at one of RAF Germany's "clutch" airfields, the Harrier squadrons are fully trained for off-base operation in ultra close-support rôles with conventional weapons from previously selected and easily camouflaged sites in the field. The Harrier wing is due to change home airfields with RAF Germany's interceptor wing at the Command's most forward airfield, east of the Rhine and some 67 miles from the border with East Germany. Each airfield in RAF Germany has its own RAF Regiment squadron of eight mobile BACGW Rapier low-level SAM fire units, while the three bases west of the Rhine each has a flight of BACGW Bloodhound 2 SAMs from a single squadron for both point and area defence.

Remaining RAF units in Germany comprise a single squadron of Wessex helicopters to provide assault and logistic support facilities for I British Corps of NORTHAG, and a communications and light transport squadron with the eight Pembrokes. By the end of this decade, RAF Germany will have about one-third of the Royal Air Force's total strength of offensive aircraft. In the early 1980s, it is scheduled to begin replacing its Buccaneers with the first of 220 MRCA multi-rôle combat aircraft. The Phantoms are also scheduled for replacement at a later date by some of the 165 projected UK air defence variant (ADV) of the Tornado.

As another important part of 2nd ATAF, the Belgian Air Force *(Force Aérienne Belge* alias *Belgische Luchtmacht)* contributes some 160 combat aircraft from a total establishment of about 400 in four strike, two all-weather fighter and one tactical-recce squadrons, plus supporting units. From its 1970 procurement of 63 Mirage 5BA fighters plus 27 5BR tactical-recce aircraft and 16 5BD two-seat trainers, the *FAeB* now operates two strike squadrons with 20 aircraft on establishment, plus a reconnaissance squadron and an OCU. Tactical Air Force Command *(Commandement de la Force Aérienne Tactique)* also administers two strike squadrons each with 22 F-104G Starfighters, and another two similarly-equipped squadrons with the all-weather intercept rôle. The latter are backed by eight Nike-Hercules SAM squadrons each with 16 launchers and 72 missiles in two *Wings d'Engins Téléguidés Sol-Air*, both based in Germany, together with two warning and control stations integrated within the NADGE chain.

The Starfighter all-weather fighter wings will probably be the first to re-equip, from mid-1979 onwards, with the General Dynamics F-16 air superiority fighters, of which Belgium has 102 on order plus options on a further 14. Other new equipment for which contracts have been placed or options taken comprise 33 Franco-German Alpha Jet advanced trainers, while recent deliveries have included 12 Lockheed C-130H Hercules, three Hawker Siddeley 748-2A freighters and six Fairchild-Swearingen Merlin IIIA light turboprop twins for the Belgian transport wing. Except for one transport squadron, all Belgian units are NATO- assigned, although some change in commitments may follow over the next few years.

Even more uncertainty characterises the Dutch contribution to 2nd ATAF, in view of recent attempts by Holland's Socialist Defence

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The Luftwaffe is engaged in a major programme to replace its F-104G Starfighters, initially with 175 McDonnell Douglas F-4F Phantoms (as illustrated) and in due course also by the Panavia Tornado. First F-4F unit to re-equip is JG 71 "Richthofen" at Wittmundhaven in 2 ATAF.

Minister to impose drastic reductions in military spending and corresponding cuts in the defence establishment. These moves were curtailed following strong NATO protests, but political problems will undoubtedly continue to complicate future defence policies. One result of recent policy changes was rejection by the Dutch Government of nuclear rôles, limiting the Royal Netherlands Air Force *(Koninklijke Nederlandse Luchtmacht)* to conventional weapons and tactics.

As a signatory to the NATO F-16 programme, with a current commitment to 84 aircraft for initial re-equipment of four of its Starfighter squadrons, plus options on a further 18, the RNethAF had its NATO tasks redefined as providing conventional offensive air capability and limited air superiority, eliminating its former high-altitude air defence and deep-penetration tasks. As currently organised, the RNethAF comprises 14 squadrons — five with F-104Gs, four with Northrop/Canadair NF-5s, one with Fokker F27s and four with light aircraft and helicopters operated on behalf of the Dutch army — at seven operational air stations.

The 168 or so combat aircraft include two ground attack, one tactical recce and two interceptor squadrons with about 98 F-104Gs and RF-104Gs, as well as three fighter-bomber squadrons plus an OCU, also with 18-aircraft establishments, operating 69 Canadair NF-5As. The RNethAF air defence organisation includes five SAM groups *(Groepen Geleide Wapens)*, each comprising three or four squadrons deployed in Germany. Two of the groups each comprise four squadrons with a total of 32 Nike-Hercules launchers, plus a further three groups with 66 launchers for 11 Hawk squadrons. Four of the Nike-Hercules squadrons are scheduled for disbandment over the next year or so, while three Hawk squadrons are due for withdrawal from Germany to Holland for air base defence. Holland is a participant in the NATO Hawk Improvement Programme, while future appropriations are earmarked for new SHORAD missiles to replace both Nike and Hawk in Dutch service.

A further Dutch contribution to NATO, this time to SACLANT, is made by the *Marineluchtvaartdienst* (MLD), or Naval Air Service. At the moment, the MLD operates a squadron of 14 Lockheed SP-2H Neptunes (not all of which are now serviceable) plus another of eight Breguet SP-13A Atlantics on ASW duties, supported by 11 Westland AH-12A Wasp helicopters from frigate stern-platforms and a Dutch shore base. Recent Defence Ministry plans to disband the Neptune squadron were dropped after NATO protests, but a go-ahead for procurement of the 13 Lockheed P-3 Orions recommended as replacements remains doubtful. Sixteen Westland SH-13A/B Sea Lynxes have already been ordered, however, as Wasp replacements from 1978 onwards and for operation (six) in the SAR rôle.

German Strength in AFCENT

Like other Federal German forces, the *Luftwaffe* combat elements are totally assigned to NATO and currently comprise 18 fighter-bomber squadrons, four tactical-recce squadrons, two missile wings and an air defence force of four interceptor squadrons, 24 Nike-Hercules SAM batteries, 36 Hawk SAM batteries and 10 associated radar sites, two low-altitude reporting battalions and integrated operations centres. With a total inventory of about 853 combat aircraft, including almost 100% reserves, plus over 200 jet trainers, more than 200 transport aircraft and 160 helicopters, in addition to liaison and support types, the *Luftwaffe*, after USAFE, is the largest single air element in AFCENT, of which it represents some 30 per cent, although its forces are distributed between 2nd ATAF in Northern Germany and 4th ATAF in the south.

For nuclear weapons delivery, the *Luftwaffe* is unique within AAFCE in operating two *Flugkorpergeschwader*, or wings, of Martin MGM-31A Pershing 1A surface-to-surface missiles, each comprising four squadrons with 36 launch ramps. With a maximum range of 345 naut mls (640 km) and normally carrying a 400-kT nuclear warhead, the Pershing is currently being fitted with the automatic Azimuth Reference System (ARS), which allows unsurveyed launch sites to be used, thus increasing operational flexibility.

Five F-104G wings classed as heavy fighter-bomber units operate 10 squadrons with 18 first-line F-104Gs in each, plus reserves, carrying either the standard NATO (US) one-megaton nuclear store or conventional ground-attack weapons. The *Luftwaffe* tactical element includes two heavy reconnaissance wings of four squadrons which recently re-equipped from 60 RF-104G Starfighters to 88 SLAR-fitted McDonnell Douglas RF-4E Phantoms. Re-equipment is now in process of the air defence force of four squadrons in two interceptor wings with 185 slat-equipped McDonnell Douglas F-4F Phantoms entering service in place of the former Starfighters from the total of 749 F-104Gs, 30 F-104Fs and 137 TF-104Gs originally procured. Two more wings — one heavy strike *Geschwader* with F-104Gs and one light ground attack *Geschwader* with Fiat G.91s — are scheduled to re-equip with F-4F Phantoms, resulting in the eventual establishment of eight intercept-strike squadrons of Phantoms in the *Luftwaffe*.

In addition to the present four interceptor squadrons, the German air defence establishment is completed by six battalions, comprising 24 batteries each with nine launch ramps and 144 Nike-Hercules SAMs, and nine battalions comprising 36 batteries each with six launch ramps, with Hawk and Improved Hawk SAMs. Some 5,240 Franco-German Roland 2 low-level SAMs, together with 143 launch units, are also on order for airfield protection.

From the late 1970s onwards, four of the heavy fighter-bomber *Geschwader* currently operating F-104Gs are scheduled to start re-equipping with the first of 210 Panavia Tornados for which the first firm orders were expected to be placed in the second quarter of 1976. The *Luftwaffe* will use its Tornados for interdiction, close air support, counter-air operations and armed reconnaissance. A further 112 Tornados are scheduled for delivery to the *Marineflieger*, to re-equip the four F-104G squadrons of its two air-to-air surface missile-armed anti-shipping strike/reconnaissance *Geschwader* for operations with NATO over the North Sea and Baltic approaches. The *Marineflieger* combat element, with an in-service strength of some 87 Starfighters, is completed by two squadrons operating 15 of 20 Breguet Atlantic ASW patrollers delivered from 1966 onwards.

Remaining *Luftwaffe* units of operational significance include four light ground attack wings, each with two squadrons with establishments of 20 Fiat G.91R/3s from original German procurement of 346, and two air transport wings of the *Lufttransport-Kommando*. Four of the G.91 squadrons, together with the OCU, are scheduled for re-equipment from 1978 onwards with 200 of the light strike version of the Franco-German Alpha Jet. The four squadrons of the *Lufttransportgeschwader*, plus an OCU, operate 18 Transall C.160D twin-Tyne tactical transports each from original total procurement of 90. The transport component also includes a helicopter *Geschwader* with four squadrons of Dornier-built Bell UH-1Ds, each with 21 rotorcraft, from 132 allocated to the *Luftwaffe* from total German production of 352.

North America in Europe

In addition to many *Luftwaffe* units of the 1st Tactical and 2nd Air Defence Divisions based in southern Germany, 4th ATAF otherwise consists of the major components of the US Air Forces in Europe (USAFE), together with the 32nd Army Air Defense Command and the 1st Canadian Air Group. Two of the three Air Forces, in fact, of USAFE — the 3rd Air Force, with HQ at Mildenhall, in the UK, and the 17th Air Force, controlled from Sembach, in southern Germany, are assigned to the 4th ATAF through AFCENT and AAFCE. The third — the 16th Air Force, with HQ at Torrejon, Spain — comes under NATO's Allied Air Forces, Southern Europe (AIRSOUTH), although Spain is itself, of course, outside the NATO area.

At the present time, USAFE operates about 600 combat aircraft in 28 first-line squadrons from some 300 operational sites in Greece, Italy, the Netherlands and Turkey, as well as Germany, the UK and Spain. From its HQ at Ramstein in southern Germany, USAFE exercises control over two tactical fighter wings, each with three squadrons of about 20 McDonnell Douglas F-4D Phantoms; one tactical fighter wing with three squadrons of General Dynamics' F-111E variable-geometry strike aircraft; one tactical-recce wing and three squadrons of RF-4C Phantoms and one tactical airlift wing with Tactical Air Command Lockheed C-130E Hercules squadrons on rotation, plus Boeing EC-135H and other support aircraft, from five US-leased bases in the UK.

In addition to these 3rd Air Force aircraft, USAFE also contributes the very substantial establishment of the 17th Air Force in Germany to 4th ATAF. Main equipment of the 17th AF is the F-4D/E Phantom, which is operated by eight squadrons in four Tactical Fighter Wings, augmented by a single additional squadron based alongside the RNethAF in Holland, and two photo-recce squadrons with RF-4E Phantoms in a Tactical Reconnaissance Wing. A supporting Tactical Airlift Wing in the 17th AF makes use of TAC C-130s on rotational visits, together with piston-engined, jet-augmented, Boeing KC-97L tanker/transports of the Air National Guard on detachment from the US.

About 30 Lockheed C-130E Hercules from Tactical Air Command in the US are normally operating in Europe on 60-day rotational visits at any one time, together with smaller numbers of KC-97Ls providing support for USAFE tactical missions. Main flight-refuelling support comes from the Tanker Task Force of some 15 Boeing KC-135s from Strategic Air Command, also operating on a rotational basis. The KC-135s provide both strategic and tactical support for aircraft of SAC and USAFE from their bases at Torrejon and Athens, including trans-Atlantic ferries and deployment of US and Central European-based fighters to some of the farthest flank airfields of NATO. Four Phantom squadrons of a Tactical Fighter Wing in the mid-west US have a regular annual deployment commitment to 4th ATAF airfields in Germany as part of the USAF's contribution to NATO.

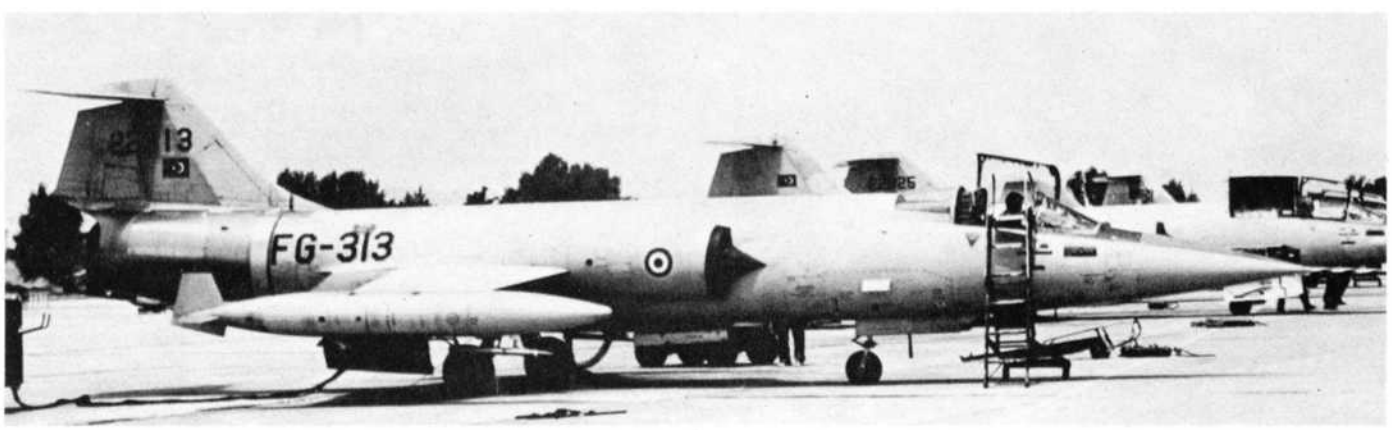
Re-equipment plans for USAFE include the scheduled arrival by mid-1976 of at least three squadrons of Vought A-7D Corsair IIs as interim ground-attack equipment pending the later arrival of the first Fairchild A-10A single-seat close support aircraft. A detachment of USAF Northrop F-5Es is also being deployed to the UK as "aggressor aircraft" to help train NATO pilots in combat tactics by simulating the MiG-21. The first McDonnell Douglas F-15A Eagle advanced air superiority fighters are expected in Europe by USAFE by late summer of 1976, probably to replace the F-4Es of the 32nd Tactical Fighter Squadron at Camp New Amsterdam (Soesterburg) in the Netherlands. At a later stage, USAFE is scheduled to receive many of the 650 General Dynamics' F-16s on order for the US Air Force, for operation on a joint basis with the NATO consortium aircraft in Europe.

The Canadian contribution to AFCENT is somewhat more modest, following the progressive reduction in recent years of the air element from four nuclear strike and two tactical recce squadrons with over 100 of the 200 CF-104 Starfighters originally ordered from Canadair to one recce and two ground-attack squadrons, restricted to the use of conventional HE weapons. The former Canadian Air Division in Europe was reduced to Air Group status and concentrated on a single airfield just across the German border from France. Main task of the Air Group is the support of 4 Canadian Mechanised Brigade Group, which includes in its German-based strength 14 Bell CH-136 (OH-58A) Kiowa helicopters. Elements of Mobile Command in Canada, including a squadron of Canadair-built NF-5s, are also earmarked for possible NATO reinforcement, with flight-refuelling assistance from the two specially-equipped Boeing CC-137 (707-320C) tanker/transports of Air Transport Command.

The Southern Situation

Principal components of Allied Air Forces Southern Europe, a subdivision of AFSOUTH, are provided by Italy, Greece and Turkey, among whom the defence of the area is shared, together with the safeguarding of Mediterranean communications and the Turkish territorial waters of the Black Sea. Unlike AFCENT, which contains the greatest proportion of NATO air power, AFSOUTH has the strongest naval element, with additional units, including maritime air, earmarked from the US Navy, with its powerful 6th Fleet, and

(Above right) Italy's Marinavia contributes two squadrons of Dassault-Breguet Atlantics to AFSOUTH, these being the 87° Gruppo at Sigonella and the 88° Gruppo at Fontanarossa. (Below) Also within AFSOUTH, Turkey contributes two squadrons of Lockheed F-104Gs to 6 ATAF, these being No 141 Squadron at Murted and No 191 Squadron at Balikesir.



the RN and RAF. Assigned formations comprise nine army divisions from Greece, 11 from Italy and 19 from Turkey, together with the tactical air forces of these countries, controlled from AFSOUTH HQ in Naples commanded by an American admiral.

For anti-submarine and shipping surveillance, British, Italian and US patrol aircraft are grouped within a special sub-unit known as Maritime Air Force Mediterranean (MARAIRMED), operating from bases in Turkey, Sicily and Italy. French *Aéronavale* units also co-operate in exercises and Portugal has a nominal assignment of one maritime reconnaissance squadron with six Lockheed SP-2E Neptunes.

Portugal's future in NATO was uncertain early in 1976, but in any case it has more than halved the size of its air force since its withdrawal from the former African colonies of Angola, Guinea-Bissau and Mozambique. There are now only 260 aircraft of all types in service, including a squadron of 20 F-86F Sabres and another of 16 Fiat G.91s as the sole combat element, also including the six Neptunes.

As with AAFCE, Allied Air Forces Southern Europe is made up of two Allied Tactical Air Forces, comprising the 5th and 6th ATAFs. In effect, however, 5th ATAF comprises only the Italian Air Force *(Aeronautica Militare Italiana)*, which contributes 19 squadrons of manned aircraft (four strike with Lockheed F-104Gs, six interceptors with F-104S, three tactical-recce with RF-104Gs, four light strike/recce with Fiat G.91R/Ys and two land-based ASW with Grumman S-2F Trackers and Breguet Atlantics) plus 12 SAM squadrons with 96 MIM-14A Nike-Hercules launchers. For additional national air defence and army support rôles, the AMI has a further five squadrons with light strike/recce, tactical transport and communications types, bringing its overall total to about 1,000 aircraft, including some 460 of first-line status. The Italian air defence system, which forms part of the NADGE chain and incorporates its own indigenous SIDA *(Sistema Integrao Difesa Aerea)* equipment, is completed by four army-operated SAM battalions with 68 MAP-supplied Raytheon Hawk launchers.

For transport support, 5th ATAF is assigned a complete medium transport wing of the AMI with three squadrons operating 14 Lockheed C-130H Hercules, some 44 Aeritalia G.222s currently being programmed to replace the remainder of 48 aged Fairchild C-119G/J transports and various supporting fixed-wing aircraft and helicopters. The AMI is scheduled to re-equip its main F-104 combat units with 100 Panavia Tornados in the 1980s, for air superiority, ground-attack and reconnaissance rôles, and is also likely to be in the market for perhaps a similar quantity of General Dynamics F-16s.

Also NATO-assigned for ASW operations are the fixed-wing and helicopter forces of the Marinavia *(Aviazione per la Marina Militare)* comprising about 18 each Grumman S-2Fs and Breguet Atlantics under AMI control but with mixed naval and air force crews, and some 35 fully-navalised anti-submarine Agusta-Bell 204AS (shortly to be replaced by 28 twin-turbine AB 212AS) helicopters and 24 Agusta-Sikorsky SH-3D Sea Kings in five squadrons.

AAFSE's 6th ATAF, nominally comprising the tactical air forces of Greece and Turkey, is of dubious effectiveness because of political disagreements between these two countries and between them and the US. Greece, in fact, has withdrawn its military forces from NATO, and Turkey has imposed various conditions on the use of its bases by American forces.

During 1975, four NATO air forces — those of Belgium, the Netherlands, Denmark and Norway — selected the General Dynamics F-16 to replace F-104 Starfighters. One of the prototypes is shown here in company with a Force Aérienne Belge F-104G.

Following the withdrawal of US aid, Greece sought new combat equipment from elsewhere, in the form of 40 Dassault-Breguet Mirage F1s from France. The Hellenic Air Force *(Elliniki Aeroporia)* is, however, still buying military equipment from the US through credit sales, evidenced by current deliveries of 60 Vought A-7E Corsair II fighter-bombers, eight McDonnell Douglas RF-4E Phantoms, eight Lockheed C-130E Hercules and 40 Rockwell T-2E Buckeye jet trainers to supplement and, in part, replace its existing inventory of three squadrons with 50 or so Republic F-84Fs, three with 50 Northrop F-5As, two with 30 RF-5As, two with 30 F-104G Starfighters, one with 15 Convair F-102As, two with 38 McDonnell Douglas Phantoms and one with eight Grumman HU-16B ASW amphibians. Transport types include some 36 Nord Noratlas and 30 Douglas C-47s. The HAF also controls one battalion of Nike-Hercules SAMs in the Greek air defence system, while the army operates two battalions of Hawks with 12 launchers.

Although US Congress finally relaxed its arms embargo on Turkey towards the end of 1975, the Turks are still restricted from obtaining US military supplies from direct government grants. Deliveries have been completed, however, of the 40 F-4E Phantoms ordered and paid for by Turkey before the US arms embargo was imposed in February 1975, and a further 40 are to be procured. Other recent Turkish procurement has included 40 Aeritalia-built Lockheed F-104S interceptors from Italy and currently in process of delivery with options for 20 more, and seven Northrop F-5As transferred by the Libyan Government as part of a $32m aid package. These are supplementing the four fighter-bomber squadrons of F-5As, two with 40 F-104Gs and three with North American F-100Ds and Fs, two tactical-recce squadrons with 36 RF-5As, and two interceptor squadrons with 36 Convair F-102As.

The THK *(Türk Hava Kuvvetleri)* air defence element also includes two battalions (six batteries) with 72 Nike-Hercules SAM launchers. Transport support is provided by four squadrons with about 50 aircraft, including eight Lockheed C-130E Hercules, about 14 Douglas C-47s, three Viscount 700s and 20 Transall C.160s transferred from Germany from 1971 onwards. Turkish Naval Aviation operates nearly 20 Grumman S-2A/D and E Trackers, plus two Grumman TS-2A trainers and three land-based Agusta-Bell 205AS on maritime patrol and reconnaissance duties.

In Malta, where the RAF Air Officer Commanding is also Deputy C-in-C (Air) Allied Forces Mediterranean, Britain has been operating a squadron of Hawker Siddeley Nimrods on maritime reconnaissance, together with a Canberra photo-recce squadron, in support of NATO's forces in Southern Europe. Under the UK's defence economy plans, however, the Nimrod squadron is due to disband by 1979 and the Canberra unit to be withdrawn to the UK.

In the current year, the 10 Eurogroup nations of NATO plan to introduce into service 156 new combat aircraft, including Jaguars, Northrop F-5Es and McDonnell Douglas F-4s; 1,524 anti-tank missiles; 71 land-based helicopters; 39 transport and supply aircraft; 437 AA guns; 172 SAM launchers and 14 maritime helicopters. Scheduled improvements will include the provision of ship-to-air missiles for six destroyers and surface-to-surface missiles for eight; new torpedoes for 110 maritime aircraft and laser rangefinders for a further 60. A further 15 Hawk systems will also be upgraded in the NATO Hawk Improvement Programme in which West Germany will equip nine battalions with MIM-23B Improved Hawks, Italy four, France and the Netherlands three each, and Denmark and Greece two each.

One of the biggest problems now confronting NATO and Eurogroup is that of arms standardisation. At the moment, NATO forces operate 31 different types of anti-tank weapons and have a further 18 under development; are equipped with over 130 main types of combat, transport, training and liaison aircraft, including 30 types in Britain alone; more than 100 different types of larger naval vessels; 36 types of fire-control radar; and 40 different gun types of 30-mm calibre or more. In contrast, the Soviet Union is believed to have only five major types of supersonic fighter under development or in quantity production, and all the Warsaw Pact countries probably have not more than about 60 different basic types of aircraft in military service. Even a moderate degree of standardisation within NATO would result, it is considered, in a substantial increase in efficiency, and this is now being sought by the Committee of National Armaments Directors as a matter of priority. □

PILOT'S VIEWPOINT

by NEIL WILLIAMS

LITURGY FOR THE LANCASTER

IF THE SPITFIRE can be described as the shield which protected us from the onslaught of the *Luftwaffe* in those dark days of 1940, then the aeroplane which enabled us to strike back, the sword of the RAF, was the Lancaster. Described by "Bomber" Harris as the greatest single factor in winning the Second World War, Lancasters flew 156,000 sorties and at one point there were no fewer than 56 Lancaster squadrons in Bomber Command. Developed from the ill-fated Manchester bomber, with its two powerful but unreliable Vulture engines, the Lancaster became as loved by its crews as the Manchester had been detested. As the war in Europe came to a close, preparations were under way for a large-scale aerial offensive against Japan. With our new found experience of the mass bomber raids in Europe behind us, it was envisaged that a large force of heavy bombers should be assembled in the Far East, under the code name Tiger Force. Included in this group was the latest version of the already legendary Lancaster bomber, the Mk VII, and of those NX611 was one of the first to reach its destination.

But even before this group became operational, the first atomic bomb was dropped from a B-29 on Hiroshima. This, together with the similar devastation at Nagasaki a few days later, caused Japan to surrender. Tiger Force went out of existence before it had even properly begun and its aircraft were dispersed. Some of the Lancasters, including NX611, reached New Caledonia, and in French maritime colours continued to give sterling service throughout the 1950s. This would have been the end of the story had it not been for the enthusiasm and determination of members of the Historic Aircraft Preservation Society. As the result of research and efforts spanning half the globe, NX611 eventually turned her nose to the north and retraced her track of 20 years earlier. On her arrival in Australia, her French crew handed her over to an experienced Lancaster team from the RAAF, who coaxed her back to England — that in itself being a tremendous achievement for both men and machine. They were given a Royal welcome at RAF stations along their route, and on many occasions were accorded the recognition of an airborne guard of honour by the resident squadrons. Finally they arrived at Biggin Hill to a tremendous welcome; the first chapter in the story was over.

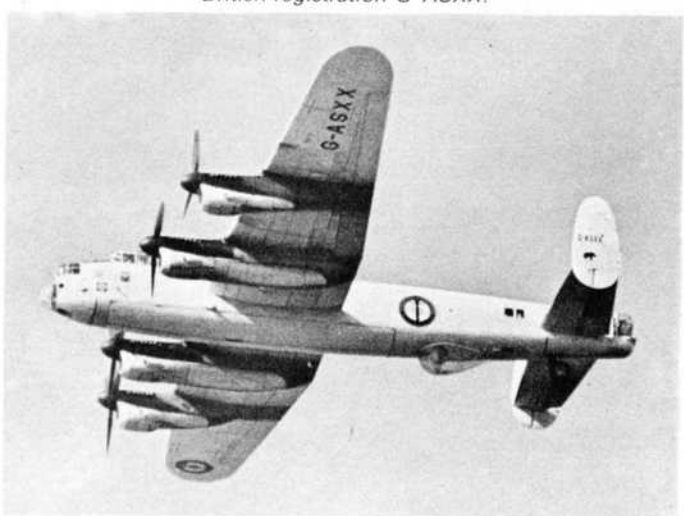
Now the work of turning NX611 into a civil-registered aeroplane began. Help was immediately forthcoming from the manufacturers and the CAA (ARB as it was then) were a constant source of assistance. The aircraft had been allocated a civil registration, G-ASXX, and a permit to test had been granted.

Since there was nobody current on Lancasters, it was necessary to find a pilot current on four piston-engined tailwheel-equipped aircraft, and as I was then flying Shackletons and Hastings, I was approached and asked if I would like to find a crew and carry out the flight testing. I had never flown a Lancaster, but as chance would have it, I had flown Lincolns for a short period. I started sounding out the flight engineers at Farnborough and was almost overwhelmed by their enthusiasm. Eventually the crew was selected; three very experienced flight engineers, all with previous Lancaster experience, and two of the most experienced navigators available. Their names were submitted to the Board of Trade, and as it turned out I was to be thankful that I had obtained such a well-qualified and steady crew.

The amount of work involved can be gauged by the fact that two years had elapsed between the arrival of the aircraft from Australia and the first test flight; but finally we were ready to go. We had already carried out engine runs and taxi tests to our satisfaction, but when we clambered over the mainspar and made our way forward into the cockpit we were all very much aware

continued on page 36

Subject of this account is the Lancaster B Mk 7 NX611 that now stands at the entrance to RAF Scampton. It is seen (above) as it was in 1967, marked HA:P to indicate its ownership by the Historic Aircraft Preservation Society and (below) immediately after its return to the UK in 1965, still in French Aéronavale markings and with British registration G-ASXX.



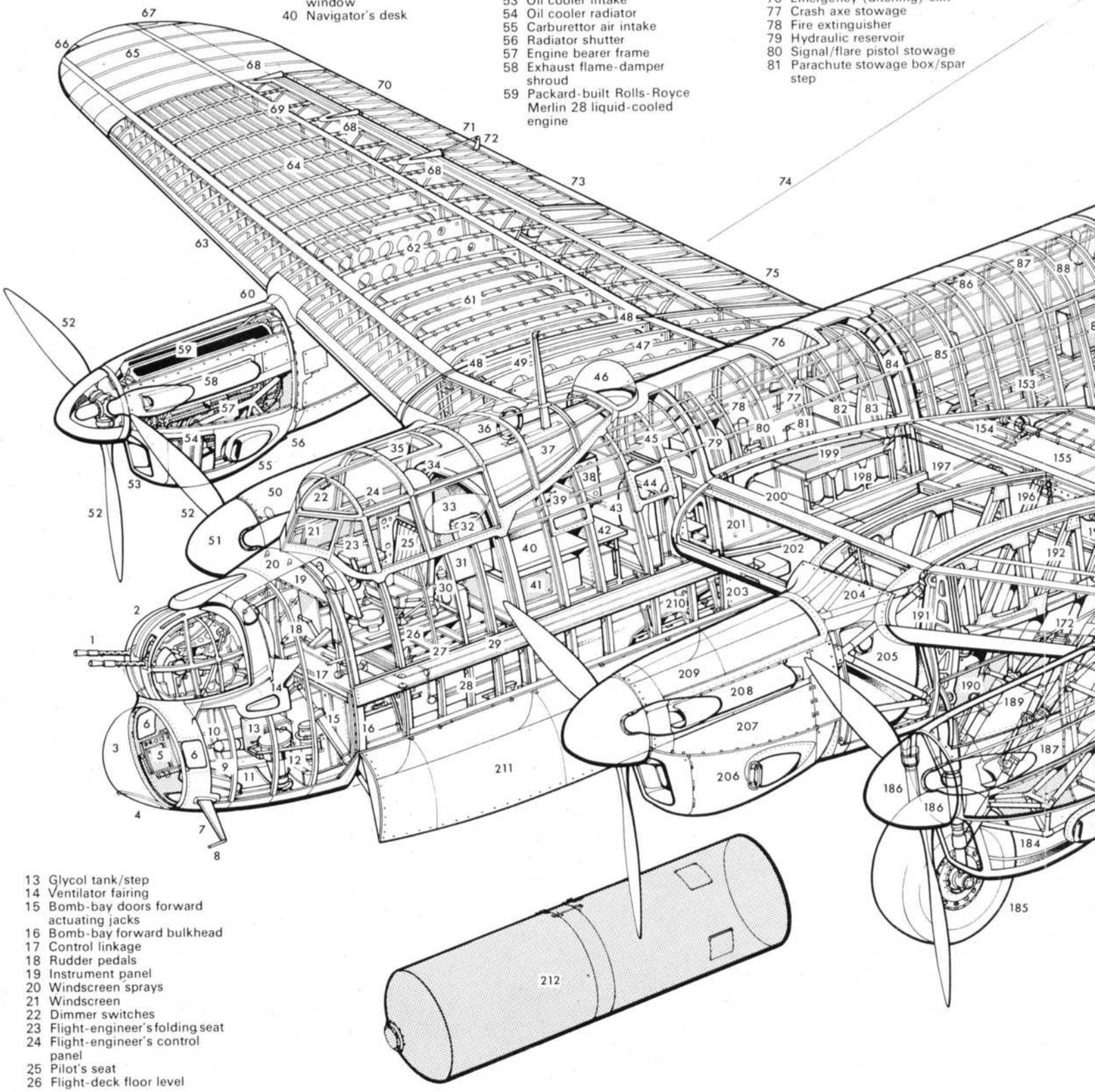
Avro Lancaster Mk III Cutaway Drawing Key

1 Two 0·303-in (7,7-mm) Browning machine-guns
2 Frazer-Nash power-operated nose turret
3 Nose blister
4 Bomb-aimer's panel (optically flat)
5 Bomb-aimer's control panel
6 Side windows
7 External air temperature thermometer
8 Pitot head
9 Bomb-aimer's chest support
10 Fire extinguisher
11 Parachute emergency exit
12 F.24 camera

27 Elevator and rudder control rods (underfloor)
28 Trim tab control cables
29 Main floor/bomb-bay support longeron
30 Fire extinguisher
31 Wireless installation
32 Navigator's seat
33 Canopy rear/down-view blister
34 Pilot's head armour
35 Cockpit canopy emergency escape hatch
36 D/F loop
37 Aerial mast support
38 Electrical services panel
39 Navigator's compartment window
40 Navigator's desk

41 Aircraft and radio compass receiver
42 Wireless-operator's desk
43 Wireless-operator's seat
44 Wireless-operator's compartment window
45 Front spar carry-through/fuselage frame
46 Astrodome
47 Inboard section wing ribs
48 Spar join
49 Aerial mast
50 Starboard inboard engine nacelle
51 Spinner
52 Three-blade De Havilland constant-speed propellers
53 Oil cooler intake
54 Oil cooler radiator
55 Carburettor air intake
56 Radiator shutter
57 Engine bearer frame
58 Exhaust flame-damper shroud
59 Packard-built Rolls-Royce Merlin 28 liquid-cooled engine

60 Nacelle/wing fairing
61 Fuel tank bearer ribs
62 Intermediate ribs
63 Leading-edge structure
64 Wing stringers
65 Wingtip skinning
66 Starboard navigation light
67 Starboard formation light
68 Aileron hinge fairings
69 Wing rear spar
70 Starboard aileron
71 Aileron balance tab
72 Balance tab control rod
73 Aileron trim tab
74 HF aerial
75 Split trailing-edge flap (outboard section)
76 Emergency (ditching) exit
77 Crash axe stowage
78 Fire extinguisher
79 Hydraulic reservoir
80 Signal/flare pistol stowage
81 Parachute stowage box/spar step



13 Glycol tank/step
14 Ventilator fairing
15 Bomb-bay doors forward actuating jacks
16 Bomb-bay forward bulkhead
17 Control linkage
18 Rudder pedals
19 Instrument panel
20 Windscreen sprays
21 Windscreen
22 Dimmer switches
23 Flight-engineer's folding seat
24 Flight-engineer's control panel
25 Pilot's seat
26 Flight-deck floor level

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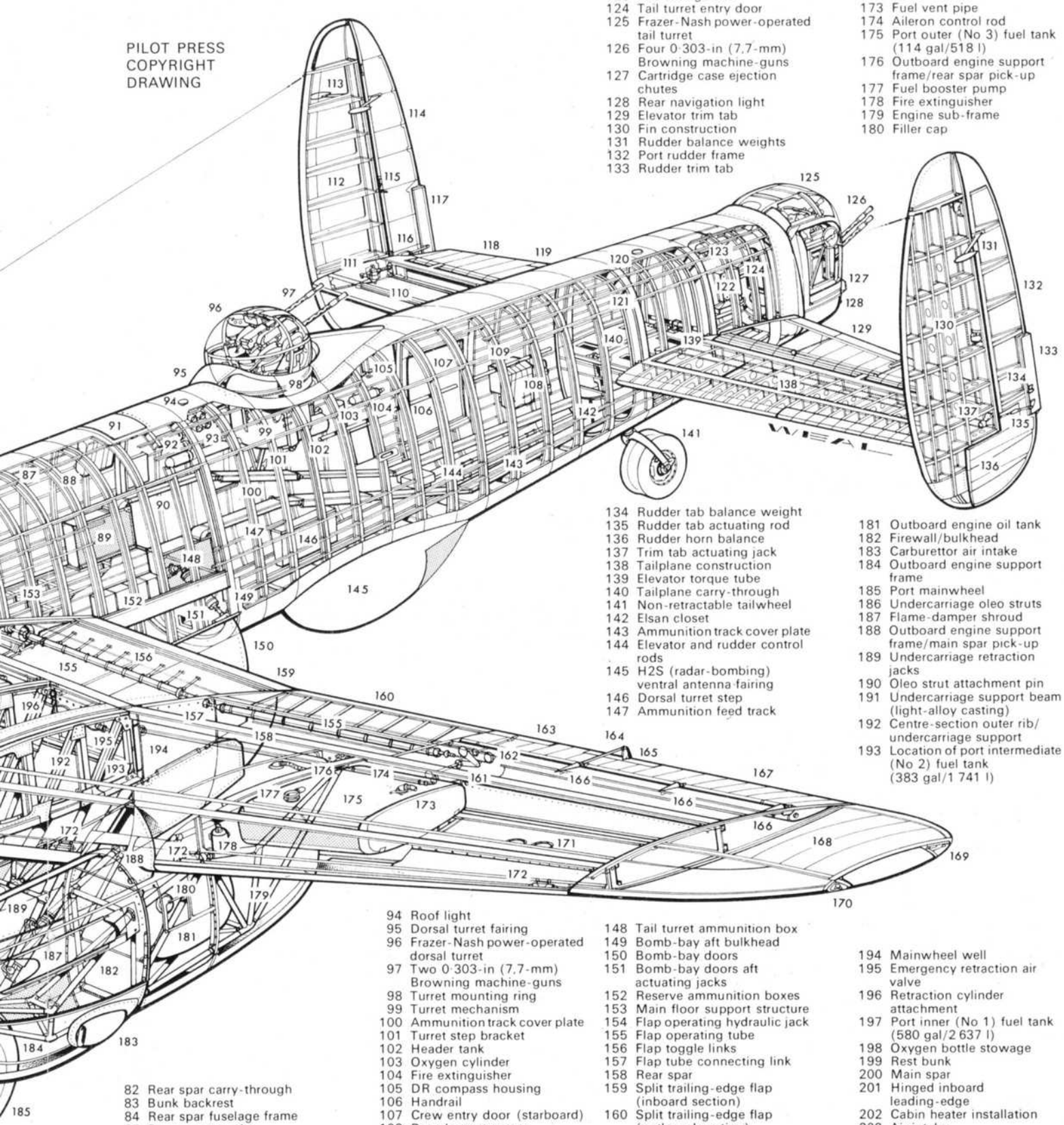
DRAWING



82 Rear spar carry-through
83 Bunk backrest
84 Rear spar fuselage frame
85 Emergency packs
86 Roof light
87 Dinghy manual release cable (dinghy stowage in starboard wingroot)
88 Mid-gunner's parachute stowage
89 Tail turret ammunition box
90 Ammunition feed track
91 Emergency (ditching) exit
92 Flame floats stowage
93 Sea markers stowage

94 Roof light
95 Dorsal turret fairing
96 Frazer-Nash power-operated dorsal turret
97 Two 0·303-in (7,7-mm) Browning machine-guns
98 Turret mounting ring
99 Turret mechanism
100 Ammunition track cover plate
101 Turret step bracket
102 Header tank
103 Oxygen cylinder
104 Fire extinguisher
105 DR compass housing
106 Handrail
107 Crew entry door (starboard)
108 Parachute stowage
109 First-aid pack
110 Starboard tailplane
111 Rudder control lever
112 Starboard tailfin
113 Rudder balance weights
114 Starboard rudder
115 Rudder datum hinge
116 Rudder tab actuating rod
117 Rudder tab
118 Starboard elevator
119 Elevator balance tab

120 Roof light
121 Tail main frame
122 Parachute stowage
123 Fire extinguisher
124 Tail turret entry door
125 Frazer-Nash power-operated tail turret
126 Four 0·303-in (7,7-mm) Browning machine-guns
127 Cartridge case ejection chutes
128 Rear navigation light
129 Elevator trim tab
130 Fin construction
131 Rudder balance weights
132 Port rudder frame
133 Rudder trim tab

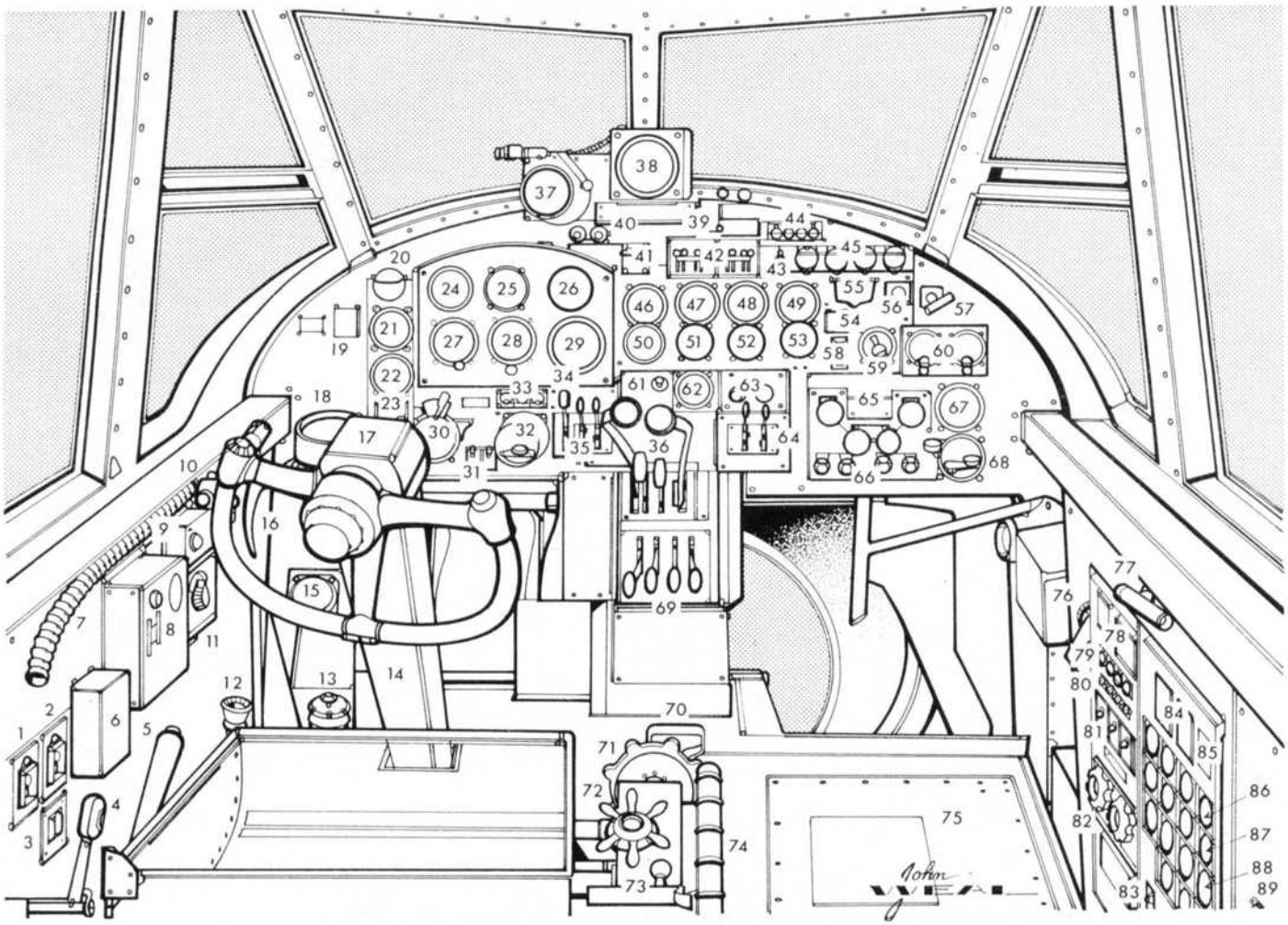
134 Rudder tab balance weight
135 Rudder tab actuating rod
136 Rudder horn balance
137 Trim tab actuating jack
138 Tailplane construction
139 Elevator torque tube
140 Tailplane carry-through
141 Non-retractable tailwheel
142 Elsan closet
143 Ammunition track cover plate
144 Elevator and rudder control rods
145 H2S (radar-bombing) ventral antenna fairing
146 Dorsal turret step
147 Ammunition feed track

148 Tail turret ammunition box
149 Bomb-bay aft bulkhead
150 Bomb-bay doors
151 Bomb-bay doors aft actuating jacks
152 Reserve ammunition boxes
153 Main floor support structure
154 Flap operating hydraulic jack
155 Flap operating tube
156 Flap toggle links
157 Flap tube connecting link
158 Rear spar
159 Split trailing-edge flap (inboard section)
160 Split trailing-edge flap (outboard section)
161 Aileron control lever
162 Aileron trim tab control cable linkage
163 Aileron trim tab
164 Aileron balance tab control rod
165 Aileron balance tab
166 Aileron hinge fairings
167 Port aileron
168 Port wingtip
169 Port formation light

170 Port navigation light
171 Retractable landing lights (port wing only)
172 Cable cutters
173 Fuel vent pipe
174 Aileron control rod
175 Port outer (No 3) fuel tank (114 gal/518 l)
176 Outboard engine support frame/rear spar pick-up
177 Fuel booster pump
178 Fire extinguisher
179 Engine sub-frame
180 Filler cap

181 Outboard engine oil tank
182 Firewall/bulkhead
183 Carburettor air intake
184 Outboard engine support frame
185 Port mainwheel
186 Undercarriage oleo struts
187 Flame-damper shroud
188 Outboard engine support frame/main spar pick-up
189 Undercarriage retraction jacks
190 Oleo strut attachment pin
191 Undercarriage support beam (light-alloy casting)
192 Centre-section outer rib/undercarriage support
193 Location of port intermediate (No 2) fuel tank (383 gal/1 741 l)

194 Mainwheel well
195 Emergency retraction air valve
196 Retraction cylinder attachment
197 Port inner (No 1) fuel tank (580 gal/2 637 l)
198 Oxygen bottle stowage
199 Rest bunk
200 Main spar
201 Hinged inboard leading-edge
202 Cabin heater installation
203 Air intake
204 Inboard engine support frame
205 Inboard engine oil tank
206 Carburettor intake anti-ice guard
207 Port inner nacelle
208 Flame-damper shroud
209 Detachable cowling panels
210 Bomb shackles
211 Bomb-bay doors (open)
212 8,000-lb (3 632-kg) bomb



Avro Lancaster Mk I Cockpit Instrumentation Key

1 Navigation lights switch
2 Auto controls main switch
3 D switch
4 Bomb doors control lever
5 Seat height adjustment lever
6 Mixer box
7 Oxygen connection
8 Beam approach control unit
9 Pilot's call light
10 Auto controls cock
11 Auto controls attitude control
12 Pilot's micro-telephone socket retainer
13 Windscreen de-icing pump
14 Control column
15 Auto controls pressure gauge
16 Brake lever
17 Control wheel mounting
18 P.4 compass
19 ASI correction card holder
20 Watch holder
21 Beam approach indicator
22 Undercarriage position indicator
23 P.4 compass deviation card holder
24 ASI
25 Artificial horizon
26 Rate-of-climb/descent indicator
27 Altimeter
28 Direction indicator
29 Turning indicator
30 Auto controls steering lever
31 DR compass switches
32 Signalling switchbox (recognition lights)
33 Identification lights colour selector switches
34 Boost control cut-out
35 Port master engine cocks
36 Throttle levers
37 DF indicator
38 DR compass repeater
39 DR compass deviation card holder
40 Landing light switches
41 Undercarriage indicator switch
42 Ignition switches
43 Booster coil switch
44 Slow-running cut-out switches
45 Engine starter switches
46 Boost gauge: port outer
47 Boost gauge: port inner
48 Boost gauge: starboard inner
49 Boost gauge: starboard outer
50 Rpm indicator: port outer
51 Rpm indicator: port inner
52 Rpm indicator: starboard inner
53 Rpm indicator: starboard outer
54 IFF switch
55 IFF detonator buttons
56 Bomb containers jettison button
57 Bomb jettison control handle
58 Suction gauge
59 Vacuum change-over cock
60 Oxygen regulator gauges
61 Flaps position indicator switch
62 Flaps position indicator
63 Supercharger gear change control panel
64 Starboard master engine cocks
65 Feathering buttons
66 Fire-extinguisher push-buttons
67 Triple pressure gauge
68 Signalling switchbox (identification lights)
69 Propeller speed control levers
70 Flaps selector handle
71 Aileron trimming tab control wheel
72 Rudder trimming tab control wheel
73 Undercarriage control lever (and safety bolt)
74 Elevator trimming tab control wheel
75 Flight engineer's station (folding seat omitted)
76 Emergency air control
77 Panel light
78 Ammeter
79 Oil dilution buttons
80 Fuel pressure warning lights
81 Electric fuel booster pump switches
82 Fuel tanks selector cocks
83 Fuel contents gauge switch
84 Oil pressure gauges
85 Pressure head heater switch
86 Oil temperature gauges (4)
87 Coolant temp gauges (4)
88 Fuel contents gauges (6)
89 Inspection lamp socket

continued from page 33

that the day for which so many people had worked was finally here. We all felt a great measure of responsibility and I could not help but wonder what my crew were thinking, especially those with thousands of hours on Lancasters, while I was about to embark on my first solo!

Starting a Lancaster is a four-handed job until one is used to it, and pilot and engineer work together. The engineer has control of the main fuel cocks, booster pump, booster coil switch, and starter buttons; while the pilot operates engine master cocks, magneto switches and throttles. Invariably one of the engines will refuse to start, so one works upon the principle that one starts the remaining engines, thereby providing the stubborn unit with what one hopes is a good example! A long-suffering groundcrew member, or on occasion an exasperated flight engineer, then has to climb onto a mainwheel, thus enabling him to reach the priming pumps located in the wheelwell (inboard nacelle). One needs to remain alert at this stage, as during these attempts to start an engine, one or more of the other three may quietly die. Since the pilot has control of the throttles he is liable to incur the displeasure of the engineer if he is sufficiently lax to allow this to happen, as in the ensuing chaos that unfortunate gentleman will be leaping on and off mainwheels with the alacrity of a mountain goat in his efforts to prime the engines. Finally the steady throb of four Merlins produces great relief in the cockpit as the checklist is continued.

On this aeroplane one has to pay great attention to the brake pressure, for should it drop, it will be necessary to stop the aircraft and to run number three engine at 1,500 rpm in order to replenish

the pneumatic supply. Taxying can be tricky, as the tailwheel does not lock, and there is a certain amount of hysteresis in the brake system. One is committed to running the inboard engines at 800 rpm to prevent the possibility of them stopping and to keep the plugs clean.

The taxying technique is to steer the aeroplane with large bursts of power from the outboard engines and to try to conserve brake pressure. It is very easy to become out of phase with the throttles, due to the initial lack of aircraft response and the associated high inertia, with the result that one weaves a very drunken path down the peri-track, with the incipient swings becoming progressively wilder, while 40,000 lb (18 160 kg) of aeroplane accelerates to the point where things very rapidly get out of hand. The only solution then is to close all four throttles and hope that there is sufficient brake pressure to sort it out. The necessity to stop occasionally to replenish brake pressure might infuriate Air Traffic Control, but at best it allows the pilot a little respite and gives him time to work out what went wrong that time!

First Solo

To a light aeroplane pilot, a Lancaster cockpit during run-up must compare well with the original Bedlam. Engines are exercised in pairs (inboards and outboards) to zero pounds boost for CSU and magneto checks, and singly to full power; this last check being carried out only because the aircraft is on test. Finally we are ready, and we are cleared into position on the runway, taking care to roll forward a few feet to straighten the tailwheel. Power is then increased to zero boost for a final check on all engines, externally as well as by gauge readings, and it is here, quite often, that one can see the coolant venting from one or more engines. However, with temperatures well within limits, we are clear to go. The brakes are released and the aircraft begins to move, very slowly at first. A good technique is to advance the port outer throttle with an extended thumb, following up steadily with the remaining engines. The tail rises of its own accord as the aircraft accelerates, and the rudder starts to become effective, though early in the take-off run it is differential throttle which provides steering.

Everything seems to happen in slow motion so that there is no need to do anything quickly. However, considerable anticipation is needed because of the high inertia. As soon as positive aerodynamic directional control becomes available, the pilot relinquishes the throttles and calls the engineer for full power. He has been following up on the throttles and advances them steadily to the stops. If the noise during run-up was high, the noise now is indescribable — so loud that it can be felt as well as heard, but unlike jet engines at full power, the song of four Merlins at +14 lb (1 484 mm HG) boost and 3,000 rpm gives a much greater impression of power, and at full power at the relatively light weight of G-ASXX, the acceleration is remarkably good.

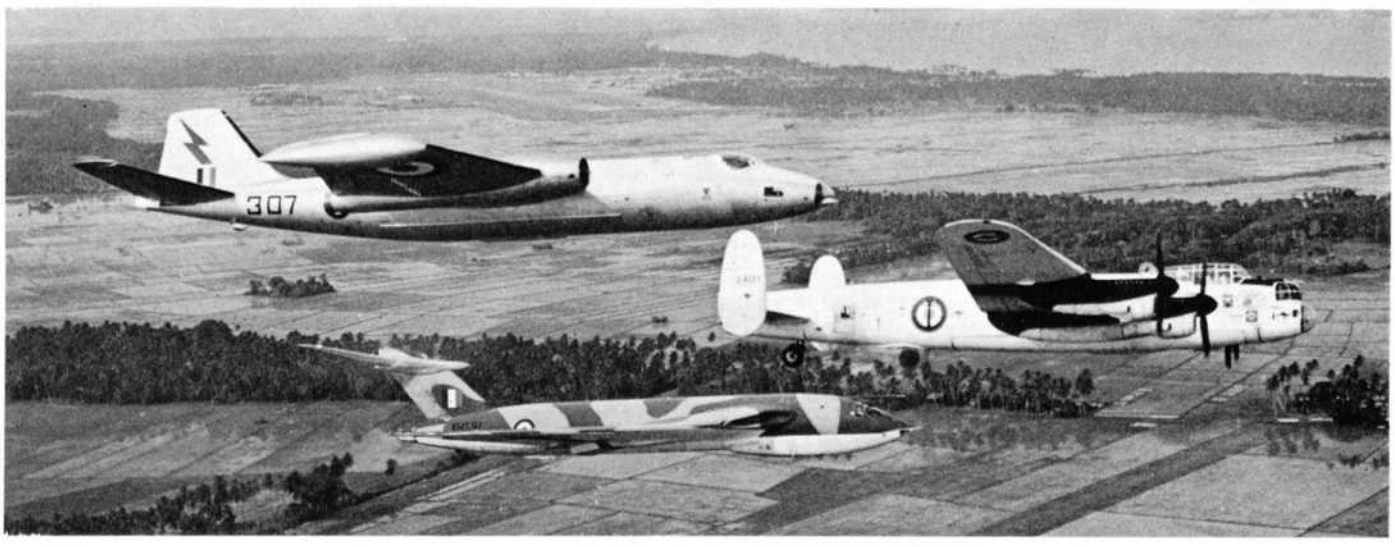
The aircraft rides well on its big tyres and requires a steady pull force to unstick. The undercarriage takes some time to retract, and it can be seen from the cockpit levering itself slowly into the inboard nacelles. The flaps are retracted in stages of 10 deg, as there is a strong nose down change of trim from 25 deg "down" to the "up" position. The flap lever is situated forward of the trimming quadrant and operates in a vertical slide. It is equipped with a spade handle at the top and has three positions: up, neutral, and down. It is only too easy to overshoot the neutral position and to start the flaps moving the wrong way! This, coupled with the very high pitch trim changes can make life just after take-off very interesting! However, on the first take-off I had briefed the engineer to operate gear and flaps, so that I could concentrate on flying the aeroplane. I have never felt happy when running old engines at full power, so it was with some relief that I noted the safety speed of 140 kts and called for climb power (+9 lb/1 225 mm HG boost, 2,850 rpm). The term "safety speed" is approximately the equivalent of the modern civil V_2, the difference being one of derivation. In fact, 140 kts (259 km/h) is the safety speed for a weight of 65,000 lb (29 510 kg), so we were in the happy position of being able to use a lower power at our lighter weight and thereby reduce the speed even further if necessary.

At a power setting of +7 lb (1 122 mm HG) boost, 2,650 rpm, the aircraft was climbing well at 145 kts (268 km/h); in fact, so well that it produced the complaint over the R/T that the photographic Beagle 206 was being left miles behind and thousands of feet below! At this power setting the Merlins sounded really sweet, especially when the engineer synchronised them. This was achieved by looking through the two port propellers and adjusting them until they strobed. The same technique was employed on the starboard propellers and then they were synchronised acoustically with the port pair. This operation was tedious and took some time, but our engineers prided themselves on eliminating any "beat" and producing the characteristic steady Merlin roar.

On this first flight I was primarily interested in proving the functioning of all systems and in familiarising myself with the aircraft. In the cruise we used +4 lb (967 mm HG) boost and 2,400 rpm. Ideally, I would have liked to use a lower rpm, but the aircraft was fitted with tropical radiators and I was concerned in case the temperatures dropped too low. At cruising speeds and moderate power settings the aircraft showed satisfactory stability, but according to Pilots Notes "there is a strong nose down change of trim as speed is increased in a dive". There is also a warning about elevator trimming in dives, and the notes go on to say that in recovery from dives the flight engineer "should be prepared to assist the pilot if required"! Needless to say, I was not interested in pushing the aircraft to a high speed, but instead I decided on a maximum IAS of 250 kts (463 km/h). Also I decided that I would not open the bomb doors in flight, for reasons of old age. The ailerons were light and crisp for such a large aeroplane; much more so than the Shackleton or even the Lincoln. The elevators were relatively heavy, as befitted a heavy bomber, but they were extremely powerful. The rudders, by contrast, were very light and had to be used with care to balance turns. There was sufficient adverse aileron yaw to require delicate and accurate footwork to co-ordinate a turn properly.

Finally, we carried out a stall check on the aeroplane in the landing configuration, using full flap, and I was very surprised to see the ASI below 60 kts (110 km/h) indicated in the full stall, although there was very likely some position error. There was

En route from Australia to the UK in 1965, Lancaster G-ASXX received a royal send-off from the RAAF base at Butterworth, North Malaya, in company with an RAAF Canberra and RAF Victor.



adequate warning in the form of elevator and airframe buffet, and the nose dropped gently at the stall. What wouldn't modern manufacturers give to have such docile natural stall behaviour! We returned to the airfield for some circuits and bumps, beginning with an overshoot from low level, and progressing through taildown wheelers to power-off three point landings.

Due to the relatively light weight the aeroplane was able to overshoot and climb away cleanly with wheels and flaps down, but needed a good push force on the control wheel to contain the strong nose up trim change as power was applied. Under these conditions I used +9 lb (1 225 mm HG) boost and 2,850 rpm, and retracted the flaps to 30 deg which gave good acceleration and a slight nose down trim change. Thereafter the undercart could be retracted with an ensuing slightly nose up change of trim. If one got the sequence of trimming wrong one was faced with quite high stick forces at low speed and altitude which could have been embarrassing. Because of the very strong trim changes when the flaps were operated in the range from 25 deg to zero, I tended not to retract further than 20 deg in the circuit. Also, because of this I decided to use a maximum flap speed of 150 kts (278 km/h) instead of the book speed of 174 kts (322 km/h).

I was surprised at the very high elevator authority, even at low speed with power off. There was no difficulty in rotating the aeroplane into the three-point attitude from a glide approach although, as I later discovered, one's judgement had to be correct. If one was a little slow in getting the stick back, thereby allowing the mainwheels to touch first, the results could be quite spectacular, since the height to which a lightly laden Lancaster can bounce is awe-inspiring, to say the least! In such a situation, there is only one answer — stick forward and full power, and go round again — one must never allow a false sense of pride to prevent a go-around! But when one "gets it right" it is very worthwhile, if only to see the engineer's disbelieving sideways glance!

Once firmly down there is no particular tendency to swing, but that is not to say that the pilot can yet relax, because if a swing develops it will take a great deal of stopping, requiring full rudder, maximum brake and probably full power on the appropriate outboard engine. As with most of the Avro aeroplanes, a successful crosswind landing depends upon preventing a wing from lifting, which was the aeroplane's first move in an attempted swing. All things considered, the Lancaster was a big gentle docile aeroplane — or so we thought after that first uneventful flight. We had yet to see it show its teeth, and we didn't have very long to wait.

Second Outing

The object of the second flight was to prove the feathering mechanism on all four engines, and to time undercarriage and flap operation. We had settled into the cruise at 160 kts (296 km/h) at 6,000 ft (1 830 m), and had feathered and unfeathered the port outer satisfactorily. Now it was the turn of the port inner. I watched the spinner slowing down as the engineer pressed the feathering button, but instead of stopping, it started to accelerate again, gradually at first, but then with alarming rapidity. I had never seen this happen before, but I knew all too well what was about to occur. I just had time to shout "runaway prop" before all communication was swamped by an ear-splitting blare of sound that stunned the mind with an awesome ferocity. I pulled the nose up as quickly as I dared, to kill the airspeed, because that was the source of the terrible energy being absorbed by the propeller. As I did so, I saw the rpm rising through 3,200 — the engineer later told me that it reached at least 3,600. He was very fast off the mark and had turned off fuel and switches, and was trying by means of the pitch lever and feathering button to slow the racing propeller. I was reluctant to throttle back the remaining engines too far or too quickly in case they too might overspeed, although I knew that we had to descend into denser air. Even at reduced power on three engines the Lancaster was climbing fast as the speed fell, so I selected wheels and flaps down — I needed high drag, and quickly.

Our troubles were not over yet, as the aircraft entered a layer of medium cloud, and as I went onto instruments, I saw that the horizon had toppled. For long seconds the airspeed hovered at 100 kts (185 km/h) while we made a slow push over into a descent, but now the three good engines were back to −2 lb (0,14 kg/cm²) boost and the runaway had stabilised at 2,400 rpm. There was no radio or intercom as these had failed when the engine had oversped. The engineer had seen the fire warning light on and had hit the extinguisher. We didn't know it then, but the extinguisher had failed to operate!

Gradually order was restored and eventually some practical engineering underneath the nav table produced both intercom and radio, the latter enabling us to make a PAN call. We looked at the port inner, spinning merrily away at 2,400 rpm and decided not to fool about with it any more. All pressures and temperatures were still within limits so I thought I would leave well alone — that propeller was spinning much too close to my seat for comfort.

It was a long haul back to the field with gear and flaps down at 110 kts (204 km/h) — I had to maintain the drag so that I could use enough power on the other three engines to keep their temperatures up. The arrival in the circuit produced a fair amount of drama on the ground, but after what we had just been through, a three-engined landing was something of an anti-climax. Sludge in the CSU was officially declared to be the culprit, and after extensive ground running the engine was declared ready for airtest.

There was a slight air of reluctance as we clambered aboard for the third time (with a lot more respect for the beast than previously). Apparently we had saved the engine from anything more than a couple of lifted seals, but I shall certainly never forget the noise that propeller made when it cut loose. Take-off was normal, although I was just waiting for an engine malfunction of some sort. As it turned out I was looking in the wrong department, albeit in the right direction. The undercarriage had just locked up and I was staring suspiciously at the port inner when it suddenly started to spray hydraulic fluid. This was instantly confirmed by the engineer who had selected flaps up with no result. We selected flaps to neutral and checked the hydraulic content, which proved conspicuous by its almost complete absence. The engineer then went aft and rummaged in the locker, where we fortuitously kept a supply of hydraulic fluid in tins — we were learning!

Meanwhile, I had the cockpit to myself as I circled the field. Finally, the engineer came up on the intercom from the centre fuselage. The plan was that they would empty the contents of their tins into the reservoir and on the word of command I would select gear down. There was much grunting and swearing, accompanied by the rattling of empty cans rolling down the fuselage, following which I selected "down". All of this resulted in one red light for the port leg, which was obviously optimistic since I was looking at the port nacelle, and I had never seen anything so firmly shut in my life.

We knew that there was only one possibility left — there is a compressed air system which should blast the gear down regardless of the position of the undercart lever; the only question was, would it operate correctly? If only one leg came down we would be worse off than ever. We discussed the situation as we circled the airfield; if we had to use the foam strip at Manston who was going to foot the bill? We decided to try the compressed air. The engineer cut the wire and pulled the handle. There was a hiss, a couple of very satisfying thuds, and two green lights stared back at me! We even had enough air to get the flaps down.

This time, the fault was obvious — an incorrect belling tool had been used, and under pressure, a pipe had blown. This was quickly repaired, but by this time enthusiasm among the flight crew was getting pretty thin and we were taking longer and longer over our preflights, with a DI (daily inspection) assuming the proportions of a minor inspection. But having shown her mettle, G-ASXX had obviously now decided to make amends. The aircraft was to be the guest of honour at the No 617 Squadron reunion at Scampton, to mark the 24th anniversary of the famous Dams raid. Almost as if she was aware of the occasion, she gave us not a moment's trouble. We flew across Lincolnshire and made a wide circuit around the city of Lincoln. We flew across Waddington where we saw PA474, the RAF Lancaster, a sentinel guarding the gate before she was brought back to flying condition; in fact we like to think that our flight that day was instrumental in achieving this.

Finally, we arrived at Scampton, where the whole station had turned out to see the Lancaster. We roared low across the field, the hangars vibrating to the thunder of the Merlins, every eye upon her, relegating even the mighty Vulcan bombers to second place. Majestic, dominant, she captured the occasion completely and, ladylike, alighted as gently as a thistledown to tumultuous applause. It was her day, and we were proud to share it with her.

With the passage of time, her fortunes changed, and she flew from place to place, searching for a home. For long years she lay abused, half forgotten, the plaything of children, but now, though she no longer flies, she has found a home: now it is the turn of PA474 to look down as NX611 guards the gates of RAF Scampton. □

SERENDIPITY AND THE 'SEVENTEEN

Just as the Avro Lancaster, described in previous pages, was the cornerstone of the RAF's heavy bomber force in World War II, so was the Boeing B-17 Flying Fortress the best-known of the USAAF's bombers engaged in the European theatre. H J "Herb" Coleman, London editor of "Aviation Week", contributes this pilot's viewpoint of the B-17, which he flew on little-known night missions in association with RAF bombing sorties.

Prologue:

14 October 1943, RAF Chelveston, near Higham Ferrers, Northants. Eight replacement B-17 pilots, lined up before Lt Col William E Sault, operations officer of the 305th Bombardment Group (H), US Eighth Air Force. "Go down to the tower," Sault said. "It's a big mission and you might learn something when the troops come back." It was, and we did. It was the second Schweinfurt raid, and of 15 B-17s sent to the ball-bearing factories, only two returned, and we knew that afternoon that all the fun and games were over . . .

RAF Chelveston was a dreary bomber base, a litter of huts and low barracks, surrounded by rolling farmland, and the centre of a sea of mud in the bad winter of 1943-44. It was still being built by gangs of Irish labourers when the 305th BG arrived, and its then commander, Col Curtis E LeMay, later recalled (in "Mission with LeMay", by Kantor), with his typical brusqueness, the shoddy buildings and runways they left behind, particularly when the runways and taxi strips began breaking down under the weight of the B-17s. That was the first operational hazard of flying in English winters, at least for green crews newly arrived from comfortable stations in the United States. I was then a crew commander and, on my first landing at Chelveston, taxied too close to the edge of a taxi strip, miring the aircraft so deep it took all 10 of us to dig her out — I was too ashamed to call for a bulldozer.

Assignment to the 305th BG at Chelveston was essentially the post-graduate course in B-17 driving, and the inexperience of the crews was a minor matter to combat pilots and crewmen who were helpful to newcomers, but not fussy. On arrival from RAF Bovingdon, where most of the time was spent at our first ever lectures on combat, I was assigned a B-17F, USAAF No 42-4515, named by a previous owner "Target For Tonite", and which I kept for 31 missions. "Target for Tonite" was more casually known as Penthouse F-Freddie, Penthouse being the call sign for the 422nd Bomb Squadron, to which I had been indentured. She was one of 12 B-17s which, not long after Schweinfurt, were painted black, the guns modified with flare shields and put on night operations, at that time as the only squadron in the Eighth Air Force to engage in high altitude night operations, mainly under Royal Air Force control. The 422nd also was the first to be equipped, outside the Pathfinder squadrons, with the then highly secret Gee receiver for a chain then in operation which extended deep into Germany. It provided a 50-ft (15,2-m) fix and even though pilots were not allowed to operate it, it became a marvellous friend in the murky weather we usually flew in, mainly when exit and entry points along the east coast were limited to precise altitudes and one-mile (1,6-km) widths. And it was then, in October of 1943, just 16 months after I had soloed in a Boeing-Stearman PT-17, that I found out what B-17 flying was all about.

I had first seen a B-17, the E-model, only eight months before and the fact that I did not run away to ask for something sensible, like the PT-17, was directly tied to that amazing military conglomeration called the Southeast Air Training Command, which took literally thousands of college boys and dishwashers — I had been both — and turned them into reasonably competent pilots in a gestation cycle resembling birth pangs in more ways than merely time. I think the time scale is pertinent, in that in less than seven months I had been turned from an addle-pated Aviation Cadet, hanging grimly to the sides of the cockpit on his first PT-17 ride, into a commissioned officer, rated a pilot in twin-engine aircraft and deemed safe for B-17s. But to get there, amid the fun and games of goggles, girls and white scarves, one had to master the PT-17, move onto the Vultee BT-13 (the famed "Vibrator") and then really get down to business by checking out the Beech AT-10 twin which had been spawned by the prewar Beech 18 line, and also another twin of such unprincipled ferocity, the Curtiss AT-9, that it should have been exported to the *Luftwaffe* free of charge. Both were difficult to taxi since we had never experienced two throttles before and instructors frowned on use of brakes, and 360-degree turns on the ramp at Blytheville, Arkansas, were common sights. But both aircraft, even the accursed AT-9, set the ground and air work for the formidable task of checking out a B-17, flying it for 125 hours, forming a crew that worked well together and then heading for combat.

It puzzles me to this dim day in 1976 how little the possibility of flying B-17s in combat, with all the potential deadly consequences, ever entered into the routine of handling, bombing, gunnery, formation, aural nulls and cross-country flying, not to mention being forced, as a cadet, to sing "Off We Go Into the Wild Blue Yonder" on the way to and from every meal.

First Acquaintance

However, the realities of life began to focus when, 15 days after graduation in the Class of 43-A, I walked around a B-17E at Hendricks Field, Sebring, Florida, and knew that I would never be able to start it, much less get it off the ground. It was enormous. The cockpit was a riot of knobs, buttons, switches and just plain *things*. The ash tray was a peanut can hung from the console. Everything was in fours, naturally enough, and the despair lasted only as long as it took to start ground school in the morning, and

Boeing B-17F Flying Fortress Cutaway Drawing Key

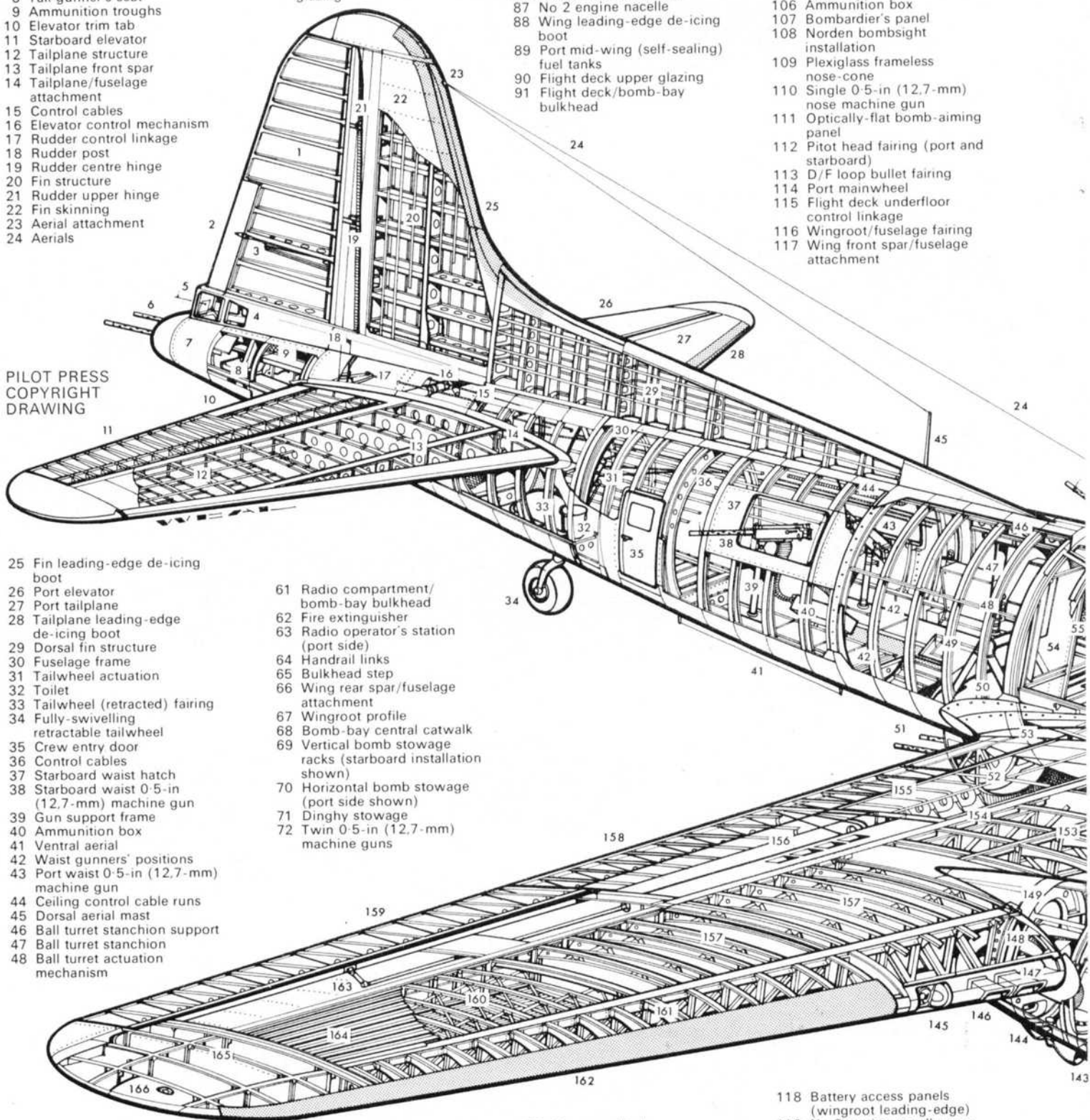
1 Rudder construction
2 Rudder tab
3 Rudder tab actuation
4 Tail gunner's station
5 Gunsight
6 Twin 0·5-in (12,7-mm) machine guns
7 Tail cone
8 Tail gunner's seat
9 Ammunition troughs
10 Elevator trim tab
11 Starboard elevator
12 Tailplane structure
13 Tailplane front spar
14 Tailplane/fuselage attachment
15 Control cables
16 Elevator control mechanism
17 Rudder control linkage
18 Rudder post
19 Rudder centre hinge
20 Fin structure
21 Rudder upper hinge
22 Fin skinning
23 Aerial attachment
24 Aerials

56 Camera access hatch
57 Radio compartment windows (port and starboard)
58 Ammunition boxes
59 Single 0·3-in (7,62-mm) dorsal machine gun
60 Radio compartment roof glazing

80 Wing leading-edge de-icing boot
81 Port landing light
82 Wing corrugated inner skin
83 Port outer wing fuel tank (nine inter-rib cells)
84 No 1 engine nacelle
85 Cooling gills
86 Three-blade propellers
87 No 2 engine nacelle
88 Wing leading-edge de-icing boot
89 Port mid-wing (self-sealing) fuel tanks
90 Flight deck upper glazing
91 Flight deck/bomb-bay bulkhead

101 Navigation equipment
102 Navigator's compartment upper window (subsequently replaced by ceiling astrodome)
103 Navigator's table
104 Side gun mounting
105 Enlarged cheek windows (flush)
106 Ammunition box
107 Bombardier's panel
108 Norden bombsight installation
109 Plexiglass frameless nose-cone
110 Single 0·5-in (12,7-mm) nose machine gun
111 Optically-flat bomb-aiming panel
112 Pitot head fairing (port and starboard)
113 D/F loop bullet fairing
114 Port mainwheel
115 Flight deck underfloor control linkage
116 Wingroot/fuselage fairing
117 Wing front spar/fuselage attachment

PILOT PRESS COPYRIGHT DRAWING



25 Fin leading-edge de-icing boot
26 Port elevator
27 Port tailplane
28 Tailplane leading-edge de-icing boot
29 Dorsal fin structure
30 Fuselage frame
31 Tailwheel actuation
32 Toilet
33 Tailwheel (retracted) fairing
34 Fully-swivelling retractable tailwheel
35 Crew entry door
36 Control cables
37 Starboard waist hatch
38 Starboard waist 0·5-in (12,7-mm) machine gun
39 Gun support frame
40 Ammunition box
41 Ventral aerial
42 Waist gunners' positions
43 Port waist 0·5-in (12,7-mm) machine gun
44 Ceiling control cable runs
45 Dorsal aerial mast
46 Ball turret stanchion support
47 Ball turret stanchion
48 Ball turret actuation mechanism

61 Radio compartment/bomb-bay bulkhead
62 Fire extinguisher
63 Radio operator's station (port side)
64 Handrail links
65 Bulkhead step
66 Wing rear spar/fuselage attachment
67 Wingroot profile
68 Bomb-bay central catwalk
69 Vertical bomb stowage racks (starboard installation shown)
70 Horizontal bomb stowage (port side shown)
71 Dinghy stowage
72 Twin 0·5-in (12,7-mm) machine guns

49 Support frame
50 Ball turret roof
51 Twin 0·5-in (12,7-mm) machine guns
52 Ventral ball turret
53 Wingroot fillet
54 Bulkhead
55 Radio operator's compartment

73 Dorsal turret
74 Port wing flaps
75 Cooling air slots
76 Aileron tab (port only)
77 Port aileron
78 Port navigation light
79 Wing skinning

92 Oxygen cylinders
93 Co-pilot's seat
94 Co-pilot's control column
95 Headrest/armour
96 Compass installation
97 Pilot's seat
98 Windscreen
99 Central control console pedestal
100 Side windows

118 Battery access panels (wingroot leading-edge)
119 No 3 engine nacelle spar bulkhead
120 Intercooler pressure duct
121 Mainwheel well
122 Oil tank (nacelle inboard wall)
123 Nacelle structure
124 Exhaust
125 Retracted mainwheel (semi-recessed)

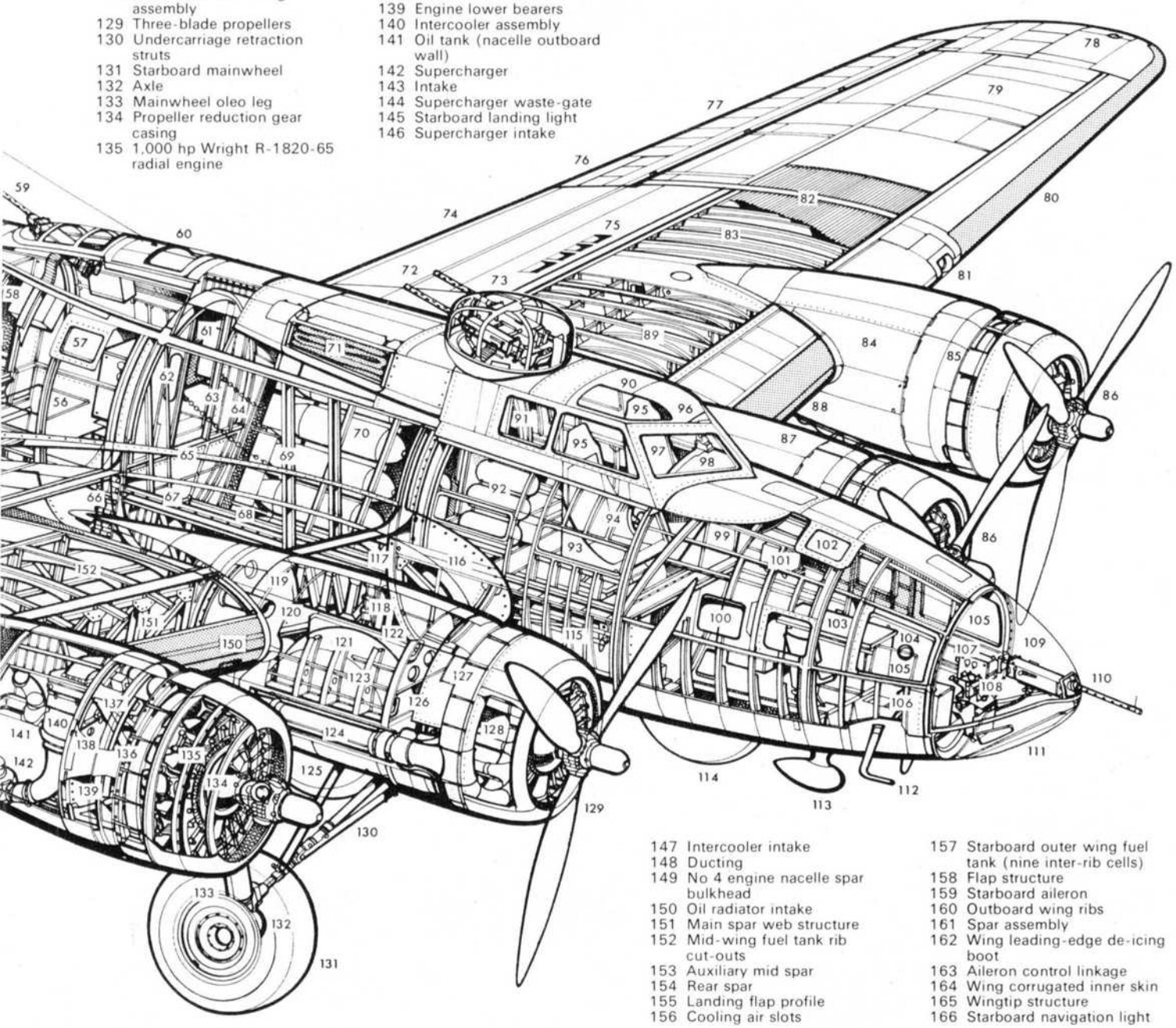
once again the system triumphed over the man. But in such a massive and accelerated programme, something was bound to fall through the cracks and with the safety of years between me and Hendricks, I will now admit that I learned what the numbers on the runway meant when I lined up for my first B-17 flight. My instructor mentioned the relationship between them and the magnetic compass and I was struck by the genius of the much maligned US Army Air Force in ever coming up with such a useful idea, when labels of A and B, or even 1 and 2 would have made more sense to me. Of such things are survivals made.

Hendricks AFB was a first pilot checkout school, its sole mission to train crew commanders before sending them to operational training units. It brooked no foolishness, wasted little time and was harsh in the extremes on pilots foolish enough to lark about in '17's; one went to prison for trying aerobatics. On my very first outing in a B-17E, I made 10 landings from the left seat and switched to co-pilot for another 10. Hendricks was equipped mostly with E-models and a few old crocks of B and C-models. The B had a huge elevator trim wheel which had to be turned one full circle for every 100 ft (30,5 m) on the final approach. It also did not have the later dorsal fin which made the '17's a classic, and tended to slide about the sky with unseemly abandon.

The B-17 (American pilots rarely called the airplane a Flying Fortress, or even a Fort — it was simply a "Seventeen") was a simple aircraft to fly, the end result of a masterpiece of sound design that cut no corners for dubious operational gains and would allow its pilots a large margin of error. It was, in the opinion of many friends in the RAF, heavily over-gunned and under-bombed, but at that time it was to be used as much for attrition of the *Luftwaffe* as it was for what we hoped would be precision strategic bombing. And it was basically designed to bring its crews back, sometimes in aerodynamic conditions little short of astounding.

The aircraft has been described as docile, but not by me. It was stable, but the pilot had to work at flying it, partly because of the large fin and tail, which precluded rudder pedal movement except at low speeds, and because the size of the wing made it an aileron platform. It turned like a truck, which is perhaps why fighter pilots called us truck drivers, and every B-17 pilot who worked at his trade ended up with a transverse welt across the palm of his left hand from friction with a twine-wrapped control wheel. Learning to fly it called for air work at Hendricks of up to 6-7 hours a day, building the techniques and confidence for flying in large formations. It started from early morning walk-arounds, mostly an almost microscopic inspection of main landing gear wheels (hard landings tended to be well-kept secrets) and to check for cracks in turbo-supercharger wheel buckets. These rotated, at full boost, at 23,400 rpm,

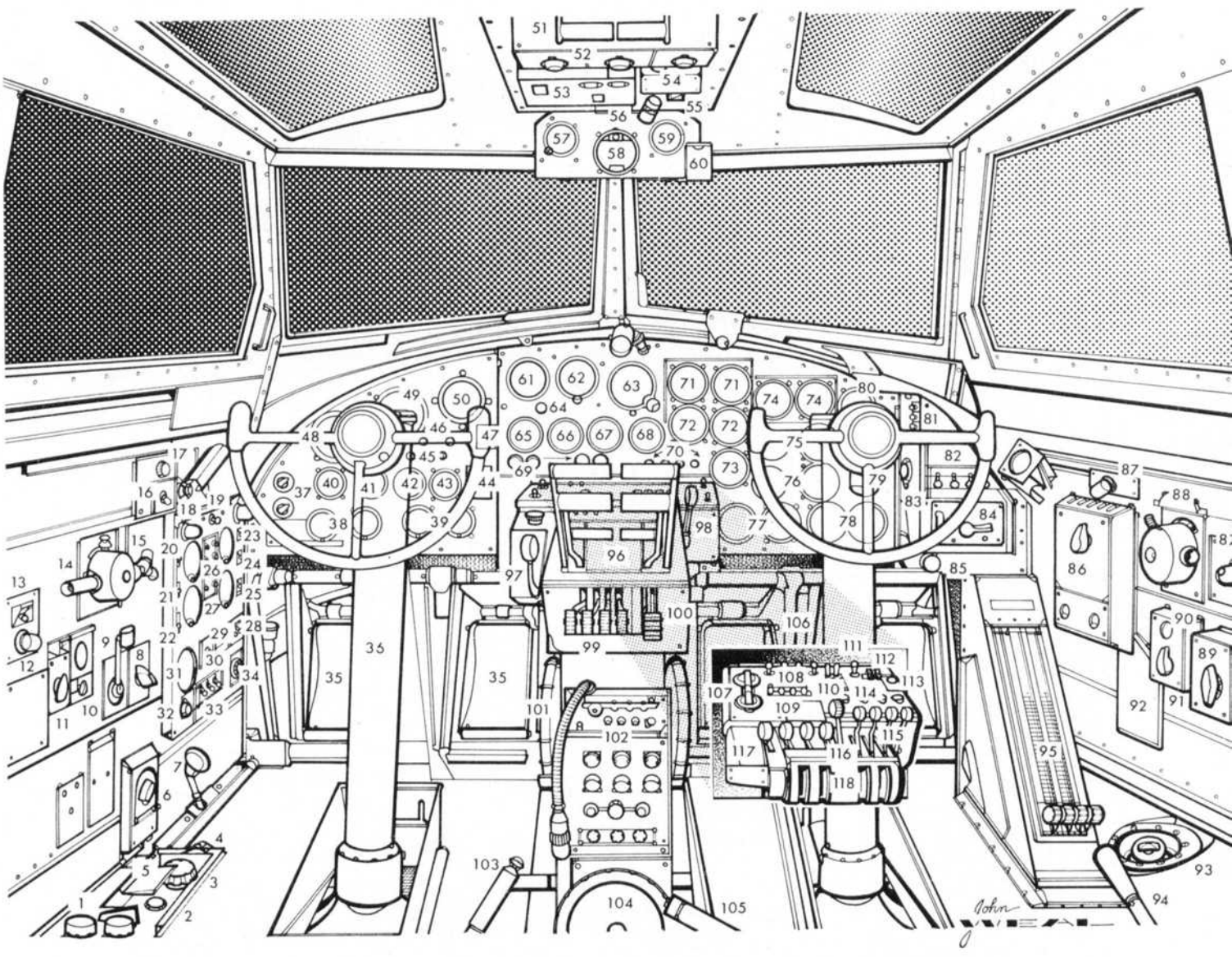
126 Firewall
127 Cooling gills
128 Exhaust collector ring assembly
129 Three-blade propellers
130 Undercarriage retraction struts
131 Starboard mainwheel
132 Axle
133 Mainwheel oleo leg
134 Propeller reduction gear casing
135 1,000 hp Wright R-1820-65 radial engine
136 Exhaust collector ring
137 Engine upper bearers
138 Firewall
139 Engine lower bearers
140 Intercooler assembly
141 Oil tank (nacelle outboard wall)
142 Supercharger
143 Intake
144 Supercharger waste-gate
145 Starboard landing light
146 Supercharger intake



147 Intercooler intake
148 Ducting
149 No 4 engine nacelle spar bulkhead
150 Oil radiator intake
151 Main spar web structure
152 Mid-wing fuel tank rib cut-outs
153 Auxiliary mid spar
154 Rear spar
155 Landing flap profile
156 Cooling air slots
157 Starboard outer wing fuel tank (nine inter-rib cells)
158 Flap structure
159 Starboard aileron
160 Outboard wing ribs
161 Spar assembly
162 Wing leading-edge de-icing boot
163 Aileron control linkage
164 Wing corrugated inner skin
165 Wingtip structure
166 Starboard navigation light

Boeing B-17F Flying Fortress Cockpit Instrumentation Key

1 Propeller anti-icer rheostats
2 Surface de-icer control
3 Aileron trim tab control
4 Propeller anti-icer switch
5 Aileron trim tab indicator
6 Suit heater outlet
7 Emergency bomb-release lever
8 Vacuum selector valve
9 Cabin air control
10 Interphone jackbox
11 Filter selector switch
12 Panel light
13 Panel light switch
14 Oxygen regulator
15 Portable oxygen unit recharger
16 Windscreen wiper controls
17 Windscreen anti-icer flow control
18 Pilot's control panel lights (left and right upper)
19 Panel lights switch
20 Passing light switch
21 Bomber call light switch
22 Interphone call light switch
23 Alarm bell switch
24 Pitot heater switch
25 Landing gear warning horn switch
26 Generator switches
27 Ammeters (4)
28 Position lights switch
29 Inverter switch
30 Hydraulic pump servicing switch
31 Voltmeter
32 Voltmeter selector switch
33 Battery switches
34 Formation/running lights switch
35 Pilot's rudder pedals
36 Pilot's control column
37 Fluorescent lights switches
38 Pilot's oxygen flow indicator and pressure gauges
39 Co-pilot's oxygen flow indicator and pressure gauges
40 Voltmeter (AC)
41 Emergency oil pressure gauge
42 Hydraulic oil pressure gauge
43 Suction gauge
44 Airspeed alternate source switch
45 3 warning lights: emergency system hydraulic oil (left), main system hydraulic oil (centre), vacuum warning light (right)
46 Bomb door position light (left) and bomb release light (right)
47 Altimeter correction card
48 Radio compass
49 Flux gate compass
50 Pilot's directional indicator
51 Emergency handbrake
52 Command receiver control unit
53 Radio compass control unit
54 Command transmitter control unit
55 Fluorescent light switch
56 Fluorescent light
57 Clock
58 Compass
59 De-icer pressure gauge
60 Compass card holder
61 Pilot's localiser indicator
62 Directional gyro
63 Flight indicator
64 Marker beacon light
65 Altimeter
66 ASI
67 Turn-and-bank indicator
68 Rate-of-climb/descent indicator
69 Propeller feathering switches
70 Bulb test button (far left), bomber call light (left), landing gear warning light (centre), and tailwheel lock light (right)
71 Manifold pressure gauges
72 Tachometers
73 Flap position indicator
74 Fuel pressure gauges
75 Oil pressure gauges (2)
76 Oil temperature gauges (2)
77 Cylinder-head temperature gauges (2)
78 Carburettor air temperature gauges (2)
79 Fuel quantity gauge
80 Free air temperature gauge
81 Oil dilution switches
82 Starting switches
83 Carburettor air filter switch
84 Engine fire-extinguisher control panel
85 Parking brake control
86 Suit heater outlet
87 Panel lights
88 Oxygen regulator
89 Filter selector switch
90 Interphone jackbox
91 Interphone selector switch
92 Check-list
93 Engine primer
94 Hydraulic handpump
95 Intercooler controls
96 Throttle levers
97 Throttle control lock
98 Mixture controls (see 115)
99 Propeller controls
100 Propeller control lock
101 Elevator trim tab control wheel (left and right)
102 Auto flight control panel
103 Elevator and rudder locking lever
104 Rudder tab control wheel
105 Tailwheel locking lever
106 Control pedestal top surface (inset) showing:
107 Ignition switches
108 Fuel shut-off valve switches (4)
109 Fuel boost pump switches (4)
110 Recognition light switches (4)
111 Landing gear switch
112 Landing light switches (2)
113 Wing flap switch
114 Cowl flap control valves (4)
115 Mixture controls
116 Turbo and mixture control lock
117 Turbo-supercharger controls
118 Throttle gate



A few examples of the famed Boeing B-17 Flying Fortress still survive in airworthy condition. This example, a B-17E, is owned and regularly flown by the Confederate Air Force, a Texas-based organisation of flying enthusiasts which owns many World War II veterans.

and if a bucket separated, it had a machine-gun effect on the fuselage as the wheel went into imbalance.

A Honeywell C-1 autopilot came with the aeroplane, a curious device studded with various control buttons. It was distrusted and rarely used, even on bomb runs when clutched into the Norden bombsight. Some marks of the B-17G were even fitted with a pilot's formation stick mounted on the bulkhead, but it was considered an invention of the devil and never used. Even on long hauls, the B-17 was so stable it was more productive to pilot proficiency to fly it manually.

Starting a B-17 involved slavish devotion to a checklist, but the sequence itself was simple, depending largely on a finely tuned co-pilot who could work the primer just a few seconds ahead of the pilot, who would energise the direct crank inertia system on a 1-2-3-4 sequence, and meshing while turning over the next engine. The flight engineer usually handled the throttles and the mixture controls, which were placed in "full rich" once the Wright R-1820 Cyclone engines had fired. The engineer doubled as top turret gunner and usually was the senior NCO, a crew being composed of pilot, co-pilot, navigator and bombardier, all officers, and two waist gunners, a ball turret gunner, a tail gunner and the engineer/gunner, all sergeants.

With four engines turning at 1,000 rpm and cowl flaps fully open, the aircraft was ready to taxi after the order for crews to take taxi and take-off positions. Magnetos were checked at 1,600 rpm and the B-17 than taxied onto the active runway for take-off, with the co-pilot locking the tailwheel during the turn; take-off with an unlocked tailwheel brought many a B-17 pilot to grief and an unusual position off the runway. A Boeing genius provided the B-17 pilots with H-shaped throttle systems, in which any one of four, or all four, could be controlled with one hand holding the cross-bar of the H. For take-off, all four throttles were pushed to full forward, with the brakes held on until full power had been reached.

The B-17 had a slight tendency to swing to the left on take-off, but this was easily countered by opposite rudder and usually, after the 115 mph (193 km/h) take-off speed was reached, the rudder pedals were not used until landing. Minimum safe speed was 120 mph (201 km/h) and the climb was usually established at 150 mph (252 km/h). The take-off and climb technique, however, called for careful control of the four turbo-superchargers to gain the maximum climb boost of 41·5 in/hg, although 38 in/hg was acceptable. The turbos had to be reset every 2,000 ft (610 m) to keep them from overspeeding and by the time the B-17 had reached altitude, the four levers were usually in four different positions, the turbos being notoriously individualistic. The later G-model provided its pilots with electronic rheostat controls, a true boon at altitude.

Boeing built a fair degree of pilot comfort into the B-17 and the visibility was excellent. It was a fine performer in formation, and with practice could be flown wing-in-the-waist window, essentially locking the wingtip into the slipstream of the leader's engines. The stall, with flaps and landing gear up, was preceded by buffeting and, at about 102 mph (171 km/h), a nose drop into straightforward recovery. With everything down, and cowl flaps trailing, the B-17

Posing at RAF Chelveston during their tour of operations in 1943/44 are the crew of "Target for Tonite", with the pilot and author of this article extreme left in the back row.

paid out at 90 kts (151 km/h) at 50,000 lb (22 700 kg) gross weight, and the buffeting was even more pronounced, rather as if the aeroplane tried to tell the pilot to stop the foolishness and get flying right.

High Altitude Capabilities

Since the B-17 was essentially a high altitude aircraft, a considerable amount of time was spent at altitudes up to 27,000 ft (8 235 m), where it tended to fly nose high and became sluggish in turns, and where the technique of anticipating closing speeds in forming up became a condition of survival. Formations at higher altitudes tended to become loose for this reason and also because, to maintain the altitude, the throttles and turbos were already fully forward just to maintain cruise speeds. The letdown started a long checklist routine, including locking of turrets and recovery of trailing antennae. The formation usually approached the field in a V, translated to echelon right on the base leg and, if pilot proficiency warranted, the landing followed a fighter-like pitchout to the left. Final approaches were usually flown at 120 mph (193 km/h) and most pilots preferred wheel landings to the three-point type, since B-17 bases usually had fairly long runways and the technique allowed quicker recovery of formations. A full flap landing was rare in that gusty conditions tended to force the pilot into fighting the wheel at low speeds and altitudes, and a three-quarter position was the norm.

Apart from a ban on aerobatics, about the only aerodynamic warning hammered into pilots was to avoid imposing excessive loads with the elevators in recovery from dives and in turns at high speeds. The B-17F flown at Chelveston was red-lined at 270 mph (434 km/h). Above 20,000 ft (6100 m) the indicated airspeeds usually were 135-140 mph (217-225 km/h) at 1,950 rpm and about 28 in/hg.

Early marks of the B-17 were fitted with a constant-flow oxygen system, an abomination which included a breathing bag that would freeze condensation, and crews maintained a cross-check on each other for the resultant anoxia. The B-17F, however, had the demand type of system which had an eyelid indicator for each position, and a 100 per cent bypass which later became an Eighth Air Force scandal when it was discovered that pure oxygen was the greatest hangover cure since teetotalling. Cold was the common enemy at high altitudes, and B-17 gunners wore heated suits and heavy leather outer clothing. The pilots' cockpit heating system, on the other hand, was excellent, and the bulky clothing, which hampered flying considerably, was seldom worn.

With Hendricks behind, and Gowen Field, Boise, Idaho, ahead, the B-17 pilot suddenly became a crew commander, forming nine strangers into a team who would stay together through combat. My co-pilot, Stanley Timone, was a P-40 fighter pilot, drafted into co-piloting almost at gunpoint but who, when he found there was no hope of returning to fighters, became first-pilot qualified in a short time. The engineer was a 33-year-old ancient who, to our shame, we called Pops, and who joined the Air Force because his lodge cronies said he couldn't make it. The operations officer at Gowen was 1st Lt James Stewart, a remote and awesome figure who later commanded a B-24 Wing in the Eighth before going back to Hollywood. The concentration was on daylight bombing on ranges near Mountain Home, Idaho, before moving on to other OTUs at Wendover, Utah, and Kearney, Neb, where we were checked out in brand new B-17Gs; beautiful aircraft which we kept for precisely one week before they were flown away, never to be seen again, and we went to Liverpool in the Cunarder *Samaria of Liverpool* and finally to Chelveston.

Lieut H J Coleman washes down the undercarriage of "Target for Tonite" after bogging down in the mud alongside the runways at RAF Chelveston.

Night Operations

There was no area checkout with a base pilot. Major Price, the 422nd commander, pointed at F-Freddie, said "That's yours, go and fly it", and that's what we did, getting lost in a matter of minutes, returning by QDM and cannon flares, to get stuck in that wretched mud. No one, least of all Major Price, ever told us why the 422nd was going on night operations, and the common view among pilots was that we were an experimental squadron, the experiment being to determine whether the ratio of losses at high altitude at nights might be a matter for discussion in the deployment of other day bombing squadrons. We did an RAF Bullseye graduation mission and were declared operational. My birthday present, on 10 November 1943, was a three-hour trip to Rouen, along with six other B-17s on some mysterious diversion ordered by the RAF on a scrambler briefing. At some point or other, we became the Eighth Air Force newsboys, cluttering the European countryside with leaflets announcing that the Allied Air Force were flying by day and by night, information already available to the readers, and to supply Occupied France with issues *(le papier hygiénique)* lavishly illustrated by photos of the Allied political leaders.

All 422nd aircraft, after briefing on flak and fighters — and if going with the RAF bomber stream, the target itself and the time expected thereon — left at 60-sec intervals, to lock onto Pathfinder marker beacons if it was a major raid. On 16 December, the RAF mounted a major attack on Hanover and we were assigned 27,000 ft (8 235 m) to drop on a yellow and green flare carpet laid down by the Pathfinders. Far below were Stirlings and Lancasters, constantly under flak and fighter fire. We were coned by searchlights, and fortunately had been trained in flying the B-17 with the seat full down, on instruments, in gyrations which were tricky at that rarified altitude, often on the threshold of a stall in a climbing turn. F-Freddie departed unscathed, was attacked twice on letdown over the Channel (its pilots, now casually smoking, thought the little balls of fire were from a flak boat until the gunners told us different), lost the inboard No 3 engine and the Gee box. But the Gee came on overhead of Thurleigh and the landing was uneventful. On a later mission to Hildesheim, F-Freddie lost two engines due to oil cooler failures, and landed at RAF Manston's massive runway on the Coast, again with no particular control problems since both the missing engines were inboards. Oil coolers had become an annoying problem which seemed to be conjoined with the supply of Cyclone engines built under license by Studebaker.

And then one day, after the 31st night mission, it was over, and 24 hours after landing at Chelveston, the crew of F-Freddie was at Port of Greenock to board the *Ile de France* for the return to the United States. The military mind decreed that, as an Eighth Air Force veteran, I should become a flight commander, teaching B-17 pilots how to fly high altitude day formation at Avon Park, Florida, and my halting "Night and Day" routine did no good to closed Third Bomber Command ears. These were mainly B-17G aircraft and the crews, after formation training, went directly to the Eighth from Avon Park. It was, for an instructor, a time of cringing at seeing a B-17G charging in at your wing because the pilot misjudged his speed, but it was a living and then one day, that too was over (I had become an Emergency Rescue Controller) and I made one last, almost pedantic, flight around southern Florida, sort of saying goodbye. I have never felt the same about any aeroplane since, and I never will.

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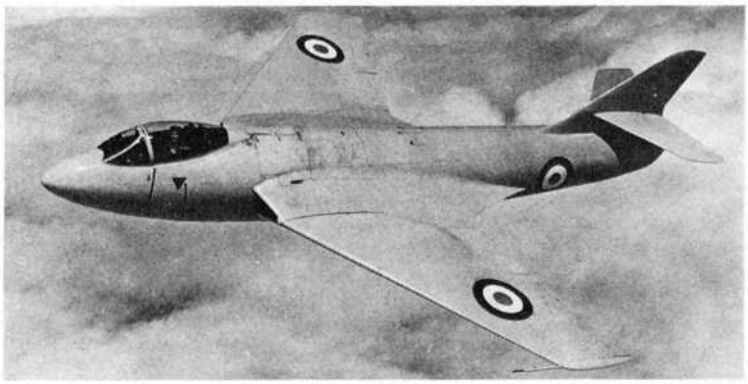
Epilogue: *The 1973 Paris Air Show, sipping a sarsaparilla or two with Air Marshal Sir Christopher Hartley, a former Controller-Aircraft of the RAF and now chairman of British Hovercraft Corp. He laughed at my theory of night loss ratios and said, in his quiet manner, that it was more important to get the 422nd into the air than that. He was then a Squadron Leader, working on a unit developing long range electronic devices, including radars, and we were the high altitude guinea pigs for confirmed positions in data collection. Nice to hear it — decades later — although I do hope the leaflets did someone, somewhere a little good, too.*



WINGS CLIPPED AND CANCELLED

The past 31 years have seen a succession of vital British aircraft projects cancelled and promising prototypes consigned to the scrap heap or the museum. The main causes have been politics, bad requirements and lack of an aviation policy. What would have happened to the Services and the industry if there had been an enlightened and continuing programme of aircraft development and production — and if aviation had been accepted from the outset as a national asset? Derek Wood, author of the book "Project Cancelled", here examines the fascinating prospect of what might have been.

THE WORLD'S FIRST AIRCRAFT to go supersonic, rows of gleaming delta wing fighters and fighter-bombers, developments of the Hunter in production in the 'seventies, an Anglo-German rocket-plus-turbojet fighter and TSR 2 as the most powerful air weapon in Europe. These are just a few of the fascinating pictures conjured up when one considers what *might* have been had Britain been blessed with commonsense and a real aviation policy from World War II onwards.

The whole sorry story of lost opportunities and abandoned projects stems from 1945. When VJ-day came, Britain had no fewer than 22 major aircraft design groups and nine aero engine groups — far too many for a country of its size and too many for any of them to be really efficient. Then was the time to start the process of amalgamation and concentration to produce the strong design and development teams so vital when technology was about to take a quantum leap forward. Instead, the Government then in office, with singular lack of foresight, left everything as it was and even superimposed on the mess a department, the Ministry of Supply, which was to become a collosus. The civil servants wanted to stay in business, so did the airframe and engine companies, and as a result they worked piecemeal on a welter of specifications and projects, any one of which could have absorbed the joint efforts of *three* companies! Right through the late 'forties, the 'fifties and into the 'sixties, only about 10 per cent of the resources necessary was available for any major programme.

Scenario: 1945

Let us turn the clock back to 1945, and see what might have been done. Instead of the Ministry of Supply, a small compact ministry is set up to deal purely with aviation: it has strong and clearly defined ties with the operational requirements and planning branches of the Services and good links with the airlines. The fiat goes out that teams must be strengthened and the number of companies reduced — otherwise no contracts. Hawker Siddeley, in particular, is told to stop internal competition among its teams and present one joint design to any particular specification. Firms are urged to specialise and stop trying their hands at everything from bombers to light aircraft. The services are informed that they must consider the civil market and exports in any transport specifications they issue.

Britain is far behind in high speed aerodynamics and there is a complete lack of understanding of what is transonic and what is supersonic. Pocketing its pride, the Government calls for the assembly of one key high speed research/design team from Germany. It is brought to Britain with its facilities and put to work alongside a group of British companies and the Royal Aircraft Establishment with the intention of producing a transonic Derwent-powered prototype of a swept-wing aircraft on which to base future military types. The Miles M.52 straight wing Mach 1·5 research aircraft is well down the road and must be continued to the flight test stage. It is, therefore, decreed that the programme be accelerated and the technical back-up reinforced. Arrangements are made for Miles to amalgamate its M.52 team with one of the larger companies, one condition being that it retains its identity as a division within that firm. M.52 contracts are guaranteed and the 5,000-lb (2268-kg) thrust Rolls-Royce Nene engine is specified.

Numerous technical problems are encountered and the first prototype is written-off in a heavy landing. All lessons learned are incorporated in the second M.52 which flies with a Nene incorporating an aft-fan and burners in the exhaust duct. In the early summer of 1947, this aircraft successfully flies "through the barrier" in level flight, months ahead of the USA's rocket-powered Bell X-1. As a result of the German team's work at RAE, three test-bed prototypes of a transonic aircraft are built which give vital aerodynamic knowledge. This is applied to a new generation of swept-wing fighters and bombers. The team is ultimately absorbed into one of the new unified industry groups.

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All this is glorious wishful thinking, but let us now take a closer look at the events of the late 'forties and early 'fifties and see what *still* might have been, even allowing for the demise of M.52, the non-use of German science and continuation of too many design teams. The Royal Air Force insisted on its own particular form of insurance in that it ordered, through the procurement offices of the Ministry of Supply, two different prototypes of everything: two fairly conventional jet heavy bombers, the Short Sperrin and the

Vickers Valiant; two advanced heavy bombers, the Handley Page Victor and the Avro Vulcan; two single-seat day fighters, the Vickers-Supermarine Swift and the Hawker Hunter, and two two-seat twin-engined night fighters, the de Havilland DH.110 and the Gloster Javelin. This represented a massive investment of money and brains but spread too thinly over too many advanced designs.

Following the Government dictum in 1945 that no war could occur for 10 years, a sense of urgency was lacking and a vital generation of intermediate aircraft was ignored. This was particularly apparent in the day fighter field. The RAF soldiered on with the Vampire and the Meteor, and the Fleet Air Arm went on ordering obsolescent Seafires, Fireflies and the like. As early as October 1945, Sidney Camm had proposed a swept-wing version of his Nene-powered P.1040 fighter prototype that Hawker was building. This was the aircraft that *should* have had full backing. Instead, the P.1040 eventually became the Seahawk and the swept versions came through slowly, first as the P.1052 and later as the P.1081. A swept-wing version of the private-venture P.1040 could have been flying by 1948 and in service in 1951. The RAF and the Fleet Air Arm would then have possessed a high subsonic four-20-mm-cannon fighter with an additional rôle as a fighter-bomber. The P.1081, as eventually flown in prototype form, proved capable of 695 mph (1 118 km/h) at sea level, Mach 0·89 at altitude and a service ceiling of 45,000 ft (13 715 m).

Scenario: 1952

How does the scene look with a P.1081 type given top priority by the RAF and the Fleet Air Arm? The time is summer 1952. The RAF has three squadrons of P.1081s in service and the Royal Navy has one, with a further unit forming. Naval jet experience has been gained with three squadrons of Sea Vampires and the straight-wing, tailwheel-undercarriage Sea Attacker has been abandoned. An RAF squadron is operating alongside F-86s in the Korean War and the naval squadron is preparing to embark on HMS Eagle *for service in Korean waters. The P.1081 proves itself a match for the MiG-15 in dog-fighting over the Yalu river, and with rockets and bombs does useful work in the ground attack rôle. The Fleet Air Arm cross-operates with US Navy carriers and for a period flies from the land base alongside the RAF.*

The results are far-reaching. There is a massive inflow into the Air Ministry of up-to-date data and many young pilots are rotated through the Korean squadron to gain combat experience. Eight RAF squadrons in Britain and Germany are equipped with P.1081s and the type forms the spearhead of Fighter Command until the full advent of the Hunter in 1955-56. The vital decision is taken to re-equip the Royal Auxiliary Air Force squadrons with P.1081s and, for export, Government finance is made available for the P.1081 to be re-engined with the up-rated Rolls-Royce Tay engine with after-burner. Impressed with the P.1081's performance, the first nation to order the type is Australia. Thereafter a total of 250 is sold abroad.

The P.1081's successor, the Hunter, is chosen as the basis for long-term development. After the introduction of the Avon Hunter into RAF service, a prototype of the P.1083 variant, with 50 deg wing sweep and fully-variable afterburning, is flown in the Autumn of 1953. It is ordered into production. The P.1083 Hunter enters service in late-1956, and the RAF has its first genuine supersonic aircraft at the same time that the US Air Force introduces the Convair F-102 delta. The P.1083 proves capable of 800 mph (1 287 km/h) at sea level and around 780 mph (1 255 km/h) at 36,000 ft (10 970 m). Export sales boom and a further development is ordered, with a two per cent thinner wing and equipped with either air-to-air missiles or ground attack weapons. Production of single and two-seat Hunters continues into the 1970s, mainly for export.

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Now we turn to that great watershed, the Duncan Sandys fiasco of 1957. Despite 10 years of blunders and bad decisions, a whole range of high performance aircraft was then on the drawing boards or being actively developed. At Manchester there was the big Mach 2·0 straight-winged bomber, the Avro 730; at Hayes, the delta wing fighters based on the brilliant, world speed record Fairey FD2; at Cowes, the RAF/RN rocket-plus-jet powered Saunders-Roe 177; at Kingston, the Hawker P.1121 air superiority strike aircraft; at Brough, the Blackburn NA.39 Buccaneer two-seat low-level naval strike aircraft, while at Preston was the English Electric P.1B Lightning supersonic fighter. Sandys, as Secretary of State for Defence, carried the full responsibility for the future of the industry. There were undoubtedly too many designs and still too many small teams. It was presumed that he would produce a logical plan and

An impression of an RAF base as it might have appeared in the late 'fifties — the Hawker P.1081 fighter (foreground) is in process of being passed on to squadrons of the Royal Auxiliary Air Force, while the first front-line unit works up on the Saro SR.177 mixed power plant interceptors flying overhead.

Two of the new RAF types which progressed some way towards service introduction before being cancelled are shown here in formation —in the foreground the BAC TSR 2 strike/reconnaissance bomber and behind it the Hawker P.1121 all-weather ground attack fighter.

strengthen both teams and facilities by reserving development and production "carrots" for those who got together. The moment was right for a big re-shaping of the industry and for the establishment of long-term programmes which would not only satisfy Service demands but ensure exports on a large scale.

Alas, it was not to be. Sandys was totally engrossed in guided weapons for which he had projects coming out of his ears. To him the robot weapon was the answer for the future. In his famous Defence White Paper of 1957, he sounded the death knell of most of the manned aircraft designs and gave the green light for a series of missiles. Even with these the same mistakes were made all over again — too many overlapping projects and too many small teams. By the time it was realised that guided missiles were not the total answer, it was too late.

Scenario: 1957

Back-tracking once again, the possible right decisions are about to be taken. Clearly not all the projects can be proceeded with; apart from cost, the duplication of types will lead to lack of standardisation and multiplicity of spares. Inevitably, the big high altitude bomber, the Avro 730, has to go, but to ensure long-term supersonic know-how, design and research contracts are issued to A V Roe for a Mach 2·5–Mach 3·0 experimental aircraft with sufficient fuel tankage for sustained supersonic flight. On this vehicle many of the problems of Concorde are destined to be sorted out. A replacement for the Canberra is essential and obviously it will be wasteful not to use the Blackburn NA.39 which is intended to fulfil a high-speed low-altitude strike rôle. After much soul-searching the RAF agrees to participate in NA.39 provided that a digital rather than an analogue system is ultimately employed, and a new Rolls-Royce engine is installed to improve take-off and radius of action in the Mark 2 version.

With the supersonic Hunter already available and the P.1B on the production line, the big question remains to sort out the SR.177, the Hawker P.1121 and the Fairey FD.2. Operational requirement No 329 for a big twin-engined high altitude fighter is abandoned as being too complex and too expensive. Instead, a requirement is issued for a supersonic single-/two-seat fighter/strike aircraft which is to become a worthy rival to the American Phantom. The contract is placed with Hawkers at Kingston and the Gyron-powered prototype P.1121, hitherto a private venture, is completed under official auspices.

Flight trials are successful and the long-term decision is taken to develop the P.1121 as a two-seat all-weather aircraft with a continuous-wave radar and a semi-active guidance air-to-air missile developed by Fairey. This missile overcomes the serious gap in British technology where concentration has hitherto been only on infra-red air fighting weapons which are unsuitable for low/medium altitude operations in bad weather. The chosen power plant for the production P.1121 is the Rolls-Royce RB.140 Medway engine with fully-variable reheat. The Government also persuades British European Airways, in 1958-59, to keep its proposed Trident airliner as a 111-seater with three Medways rather than scaling it down with a smaller power plant. The Medway is thus established in both military and civil fields, and in the latter becomes the key rival to the Pratt & Whitney JT8D, powering the Trident, the Boeing 707 and a second generation V.1000 airliner with underwing pods in place of buried engines. The Medway begins life at 10,000 lb (4535 kg) thrust and is steadily developed to 12,000, 14,000 and then 17,000 lb (5 445, 6 350 and 7 710 kg) — keeping pace with both military and civil demands for increased power. For Rolls-Royce there is an additional bonus as the P.1121 installation gives the company vital "hot back end" experience which is read across into the "Super Conway" which eventually emerges as the RB.211.

The Mark 1 P.1121 goes into RAF service in 1962, and sells extremely well abroad. The development cycle is maintained, with greatly increased weapon load and range as more thrust becomes available. A version with completely up-dated avionics, new weapons and short field performance, is a standard RAF squadron type in 1976. Sorting out the FD.2 and the SR.177 proves to be a more difficult problem. It is realised that Britain cannot go it alone for ever with rising costs and budget limitations, and that the European industry is re-establishing itself. At top level the Government decides to use both types as the start of "collaboration" and as a means of combating the tremendous sales efforts being made by the United States.

Neither the BAC TSR 2 nor the Hawker P.1081 progressed beyond the stage of flight testing, a single prototype of each being completed. No orders were ever placed for the Hawker fighter, but the TSR 2 was already in production when the cancellation order came in 1965, with more prototypes ready to fly and production aircraft in assembly jigs.

Negotiations with the Federal German Republic (begun in 1956) are completed for the joint development and production of the SR.177 rocket-plus-turbojet interceptor. As Armstrong Whitworth is to be the main UK production centre, the aircraft side of Saunders-Roe is taken over by Hawker Siddeley and the de Havilland Engine company is absorbed into Rolls-Royce. Two variants of the SR.177 are agreed upon: the basic mixed power, rapid-reaction, high-altitude interceptor for air force/naval use, and a medium-low altitude strike/fighter variant with turbojet only, rocket fuel tankage used for kerosine and a four per cent thickness wing being employed. German pressure leads to the adoption of a Rolls-Royce turbojet in place of the Gyron Junior. The Ministry of Defence agrees to three RAF Squadrons in Germany being equipped with SR.177s, while the type becomes the standard Fleet Air Arm fighter. Both the Luftwaffe *and the German Navy adopt the SR.177 as standard, and the joint production programme becomes the largest in Europe. The Lockheed bid with the F-104 Starfighter comes to nothing.*

In the case of the FD.2, Whitehall opens discussions with the French on a collaborative agreement between Fairey and Dassault. Information is pooled and joint airframe development started. A batch of six aircraft is ordered in both France and Britain, the former with the SNECMA Atar engine and the latter with the reheated Avon. The outcome is a basic Mach 2·0 aircraft which becomes standard in France and, in Britain, begins to replace the Hunter in 1962. With steady development, the production lines keep rolling to meet export orders, right through to the 'seventies.

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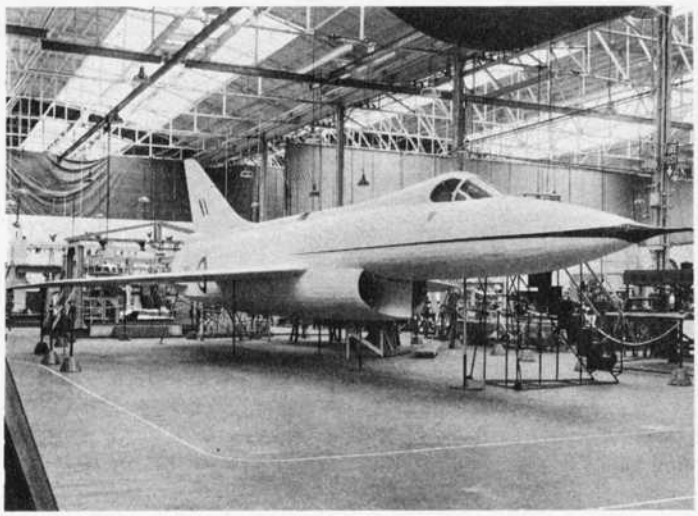
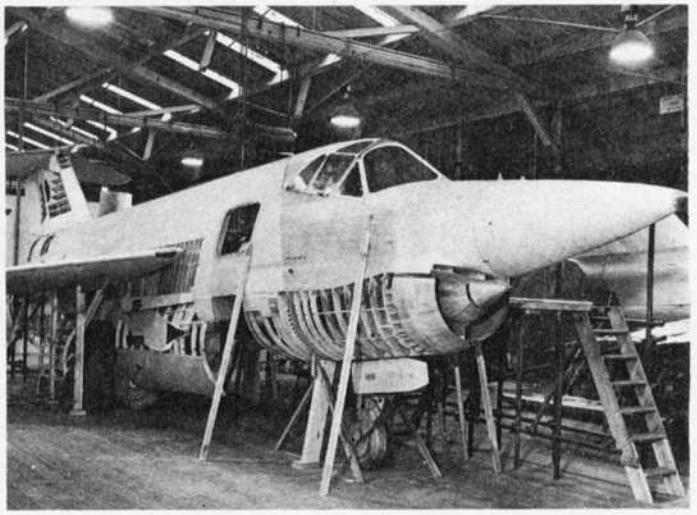
Finally, the focus must inevitably turn to the last great bureaucratic lurch towards doom which took place in 1965. None of the brilliant decisions just outlined was taken and the RAF was left with the





Both the Hawker P.1121 and the Saro SR.177 reached the mock-up stage, illustrated here (left and right respectively), but neither flew even as prototypes. Manufacture of the first P.1121 had begun when work on the project was stopped, and two prototypes of the Saro SR.53, a forerunner of the SR.177 concept, were flight tested.

TSR 2 strike reconnaissance aircraft, the HS 681 V/STOL transport and the HS 1154 supersonic fighter/ground attack aircraft, as the only really advanced projects in the country, apart from the Concorde airliner. As everyone knows, the government of the day cancelled first the HS 681 and the HS 1154, and then wrote off the TSR 2. Britain's Prime Minister, Mr (now Sir) Harold Wilson, then went to the USA and proceeded to buy the Hercules transport and the Phantom fighter, followed a little later with an order for the F-111 variable-geometry fighter-bomber. There was little or no long-term saving.

If the scenario had been different, what then? When Labour came to power there was insufficient money to develop three entirely new aircraft but there was an absolute necessity to maintain advanced aviation technology and to pump funds into research and development. The opportunity existed for tough bargaining with the United States to the mutual benefit of both countries.

Scenario: 1964

Once again we enter the realms of what might have been. Ignoring all the prophets of doom and the left-wingers who want to turn aircraft works into jam factories, the Cabinet thrashes out a workable policy. A team goes to Washington determined on maximum "buy back" for any orders placed. McDonnell Phantoms for the RAF and the Royal Navy are ordered as standard, off the line, with General Electric and not Rolls-Royce engines. This cuts the ultimate bill by two-thirds and allows re-ordering to take place at a later date. In return, the US Government agrees to collaborate on financing supersonic V/STOL development in the United Kingdom and to the purchase of an agreed list of electronic and other equipment.

To meet the transport requirement a licence agreement is concluded with Lockheed for the manufacture in Britain of the Hercules, with improved STOL performance and powered by Rolls-Royce Tyne engines. The licence includes the right to sell military and civil Hercules to specified territories. With the money saved on the Phantom deal and the dollar research cash from the USA, the V/STOL programme is initiated. The Harrier Mk 1 goes into production while, at the same time, three prototype P.1154s are built using Pegasus engines with plenum chamber burning. These are followed by a further three modified aircraft equipped with the BS.100 engine. Following extensive trials, the P.1154 is ordered as the successor to the Harrier. It is used by the RAF, the Fleet Air Arm, the US Navy and the US Marine Corps. A British-designed nav/attack system, including volumetric radar, is fitted to the P.1154.

Finally, the thorny problem of TSR 2 is resolved. So much money has been spent and so much effort put in, it is obvious that the project must go on. Sixty TSR 2s are ordered, but initially with less sophisticated equipment than originally envisaged. The weapons system package is built up gradually, allowing for an easier flight test programme. TSR 2 becomes the most potent strike/recce aircraft in the NATO armoury. A further 25 are ordered and Australia, thoroughly disenchanted with delays and price rises on the F-111, cancels its order for that type and turns to TSR 2, with major sub-contracts being placed with Australian companies.

In 1968, after NATO has abandoned the "Trip Wire" policy of nuclear retaliation, it becomes clear that the Soviet conventional build-up will require the operation of a very-long-range air-to-air missile/gun-equipped fighter capable of CAP as far north as the arctic circle. The TSR 2, with its massive internal and external fuel/weapon capacity, is the obvious choice. An initial batch of 50 "Air Defence Version" TSR 2s is ordered and at the same time a further batch of strike aircraft is put in hand specifically for maritime operations.

In order not to waste all the variable-geometry know-how accumulated in Britain, an experimental TSR 2 is flown with VG incorporated and research is kept up. At the same time negotiations are begun with a group of European nations, including West Germany, for a variable-geometry fighter/ground attack aircraft to be the ultimate successor to the F-104.

Alas, this attractive scenario, like the others we have pictured, was not to be. The Royal Air Force (and the Royal Navy) of the late 'seventies flies equipment that is still among the best in the world, and much of which owes its origins to the genius of British designers and the skills of British engineers and craftsmen. But how much better-equipped it might have been, for no greater outlay of taxpayers' money, if wiser counsels had prevailed and better decisions had been taken at any one of a number of significant turning points in the past 30 years.

Wisdom with hindsight? Maybe. Yet it seems the lessons have still not been learned. Britain is even now failing to follow up her lead in V/STOL strike aircraft and allowing the USA to build a new generation upon the hard-earned Harrier experience; there is virtually no design activity underway in the military transport field and the threat of cancellation ever hangs over MRCA — perhaps the last great opportunity for government and industry together to give the RAF another world-beater and to provide the basis for a strong and viable export programme right up to the end of the 20th century. □

Another victim of the wholesale cuts in new defence equipment made by the Labour government in 1964/65 was the Hawker Siddeley HS 681, an advanced V/STOL transport using vectored thrust engines similar in principle to the Harrier's Pegasus.

FLYING THE FLAG AT FARNBOROUGH

Participation by the Royal Air Force provides one of the high points of the biennial SBAC Flying Display at Farnborough. Here, Sqdn Ldr David Lott, No 1 Squadron RAF, describes his experiences at the 1974 event.

I LOWERED my Kawasaki motorbike gently to the ground for the umpteenth time. I am getting quite good at unloading the thing from the back of a four-tonner. Allowances don't run to company cars in the Royal Air Force, so it is economic to take my two-wheeler with me wherever I go. I didn't ride it much this week though. Anyone who went to the last Farnborough International needed oilskins just to be a spectator, let alone ride a motorbike.

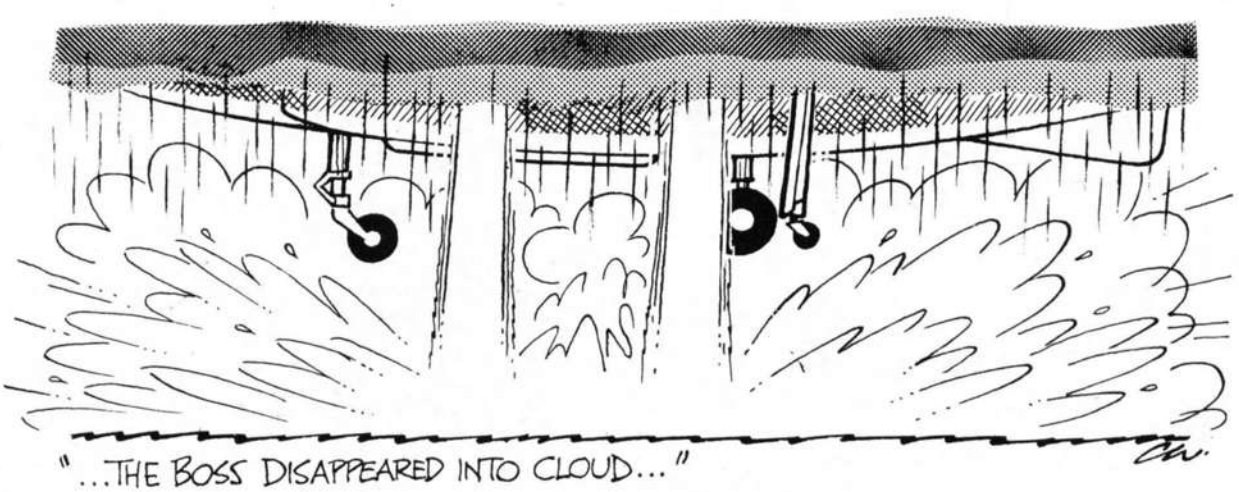
I had set off from RAF Wittering in my Harrier jump jet some time after the Kawasaki had left. I was No 3 in a 10-aircraft formation. We flew down to Farnborough over Bedford, passed east of Reading over Henley-on-Thames and lined up with the runway in a 10-aircraft echelon. Unfortunately the leader did not get it quite right and after a monster "yug", the aircraft outboard of No 5 decided to act independently in the most flexible traditions of the service and we arrived as two fives!

A quick buffet lunch, brief and airborne — no, wait a moment: what has parked with its wing over one of our vertical landing pads? An immovable StarLifter — oh well, we will just use six aircraft. Apart from one aircraft failing to rise gracefully off the ground and one bogging in on the grass, those that limped into the air completed a skeletal practice. Let's try again. We had to get a spare aircraft airborne and this time I got much too close on the mock attack, so forcing my No 2 to overfly the tent that in two days time would house the president of the SBAC and his VIP guests — an unforgivable crime. We were so short of fuel we did not do any jetbourne manœuvres at the end, to my great relief as my engine was running a bit hot. I don't think the Air Officer Commanding was impressed (I wouldn't have been in his position) and he changed the format for the better.

Next day we tried the wet weather programme, which was not really for wet weather, but in case of fog! The first attempt was another disaster, with aircraft again failing to struggle up to the awaiting sky hooks and poor old Dudley Carvell gently dropping back to the runway; he probably picked up some of my hot air, but it was nothing like the hot air *that* practice generated. Our Staff Officers from 38 Group were at their wits end. All very tense.

Then at last, a decent rehearsal — SASO came to watch and, despite three nosewheels stuck down, all went quite well! Tom Plank in the solo aircraft got a low warning which was a pity as the spectators said it looked very impressive. However, he will have something to tell his grandchildren in the States (he *is* American, but not that old, even if he does cover his captain's bars with clear plastic — he's had them so long he is frightened they will corrode!).

The day before the first show arrives and we put on our display for the Flying Control Committee, passing muster with no awful

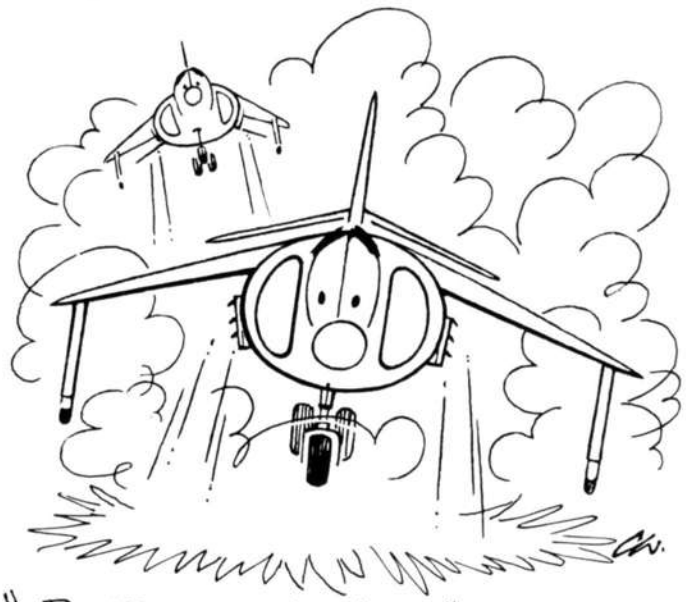


violations. The engines of the aircraft doing the vertical take-offs seem to be OK now. It was just an adjustment to the jet's equivalent of a carburettor flat spot that was needed. After his warning, Tom has cut out his low pass and is doing a steep deceleration instead. We had to do some *ad lib* hovering manœuvres while we waited for the Jaguars to interlock with our performance. We experienced our first taste of blustery weather on this practice, which was a mild portent of much worse to come.

1 September — the first show day: cold, windy and very, very wet! I went to the briefing in the pilots' tent at 1130 hours; it went on for a long time but I was left with an impression of smooth efficiency. I had that feeling of settling into a well worn groove although we had not even started the daily show routine. All the aircraft are serviceable, but we have a refuelling tanker stuck next to a pad; we move it with half-an-hour to go. I think we all have a slight touch of pre-display nerves although no one will ever admit it.

We are sitting in our aircraft ready to go when a helicopter, the Sikorsky Blackhawk, crashes in full view of the crowd and us, and bursts into flames. The cockpit breaks off on impact, but one pilot is killed instantly and the other fatally injured. It is not a good way to start a display. All, however, goes well, despite the conditions. The reactions of the others to the crash were similar to mine — we were all glad the show went on, but I had a hollow feeling in the stomach; a heightened awareness, a shadow of fear to be forgotten the moment we started our display. There is no room for any emotion, anger, fear, joy or shame under the intensely high work load under which we operate during a V/STOL tactical display. Emotions bubble over once the wheels are firmly on the ground at the end of the show.

Two displays later. The weather has been appalling. I watched Concorde come in sideways into the crosswind and shuddered at the thought of how we were going to cope. The event is not so bad as the anticipation, and the flying goes without a hitch; we just cut out Red section's hovering, thank God. McDonnell Douglas are entertaining us this day. Immediately after landing, we leap out of the aircraft onto a Landrover, debrief on the way to the host's chalet and there is a double scotch on the rocks in the right hand



"...PICKED UP MY HOT AIR..."

before the big fans of our jet engines have rattled to a stop.

Every display is different. On 3 September, we took-off into a very heavy rain shower — the Boss went into cloud and I nearly had kittens as he disappeared. We were a little slow getting in close as a result, but under the conditions I was impressed with our ability to survive. When will this weather improve? My day was made today. A little waitress at the Plessey chalet tugged my uniformed arm after coffee this morning, and wished me "good luck, sir". I left feeling 10 feet tall.

The things we do...

The Royal Air Forces Association always strives to provide the best in welfare services for those who have served, or are serving, in the Royal Air Forces.

Take Sussexdown, for instance,

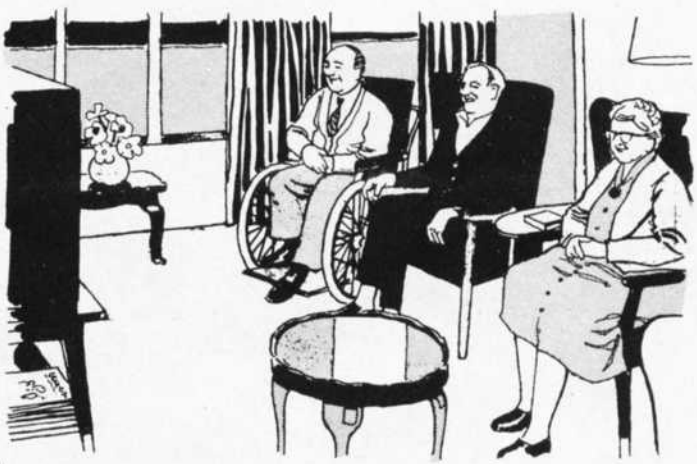
the Association's home for the permanently and badly disabled who are alone with no family to look after them. And Richard Peck House, its convalescent home by the sea for men and women, and members of their families, who need care and attention after illness.

Then there are all the other welfare services, from pensions to housing, and from employment to legal matters, in which the Association's specialists are always ready to help, working in close harmony with the RAF Benevolent Fund.

with the help of people like you.

It is all made possible through the enthusiastic efforts of the members of the Association—there are more than 105,000 throughout the world—and the support of people like you. The fact that you have purchased this Year Book has helped!

Sussexdown alone costs over £3,000 a week to run with its expert medical and nursing facilities. But with the help of people like you we will continue to provide the best we can for those who really deserve it.



For their sake, please don't stop.

The Royal Air Forces Association
Central Headquarters 43 Grove Park Road London W4 3RU

...A LOW WARNING...

The weather continues unabatedly bad. At the briefing this morning we cheered the met man with his talk of hurricanes — and he didn't mean the Second World War variety either. Here's a few phrases heard this afternoon: "Mind the TriStar"; "Good, the wind will be blowing straight down my vane"; "We hardly ever get the chance to bullshit", and "The Galaxy is too big to be moved".

Wives and girl friends came down on the 5th. There was a bit of embarrassment over lunch at a chalet. I shall not name the firm as they were very generous to us later. We were invited for lunch — asked to leave as there was no room — re-invited — re-thrown out — re-invited — had an excellent lunch rather red in the face with our hosts in a tizz; God knows how *that* outfit builds aeroplanes, and good ones, too!

I will soon be completely white. What a terrifying landing. It was pouring with rain and the runway was flooded. At about 20 ft (6 m) I disappeared in either my own or Pete Martin's steam. Instrument flying in the hover is a new experience that I don't recommend. I just sat holding everything still until the ground rose to meet me — I couldn't see a thing. I throttled back but couldn't prevent ballooning when I finally hit the ground. Plessey provided the nerve-restorative double scotch. Every evening Plessey sends beer for our groundcrew. They all seem to know exactly which bits they make for our Harriers; a very switched-on outfit.

We had some publicity with the crews of the Lockheed SR-71 record-breaking aircraft; I think their jet upstaged anything else at the show. They are an exceptional band of guys. We parked our Mach 0·00 jet next to their Mach 3·0 near-space ship and swapped jokes and plaques while I hung on to my wife!

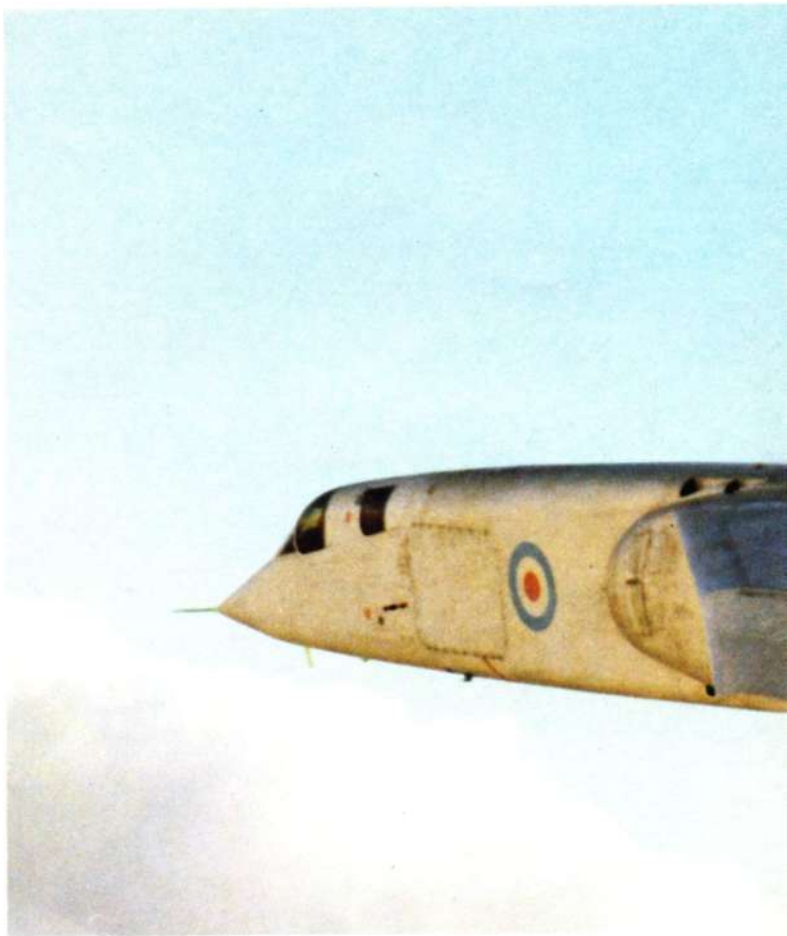
On 7 September the met man's hurricane arrived! The main exhibition hall had to be closed as it was flapping about so much. The pilots' lunch tent with a crew of 175 was reported to be replacing Concorde in the programme and was reliably described as yet another Royal Aircraft Establishment first. We ignored the wind and did the full programme.

There was quite a sense of occasion at the briefing this morning. John Tosland who runs the immensely complicated air traffic set up, was leaving to return to normal duties and Wing Commander Clive Rustin on the flying control committee was posted. Even the met man was warmly applauded. Pilots can achieve the most remarkable rapport amongst themselves, and so it felt today. The programme went without a hitch. As I climbed out of my cramped little cockpit after the last display and watched the other eight pilots walking across the sodden ground to the awaiting Landrovers, I felt proud to belong to such a professional team.

Hawker Siddeley aviation threw a superb party for us and the Red Arrows that night. I awoke next morning socially exhausted, looking forward to going home but already so nostalgic. The next Farnborough Display (starting at 1430 hours on 5 September 1976) couldn't come too soon for me. □

AIRBORNE IN THE TSR 2

At the time of its cancellation in 1965, the TSR 2 was performing exceptionally well in flight test. A "pilot's viewpoint" is here provided by Wg Cdr R P Beamont, who was in charge of the TSR 2 flight test programme.

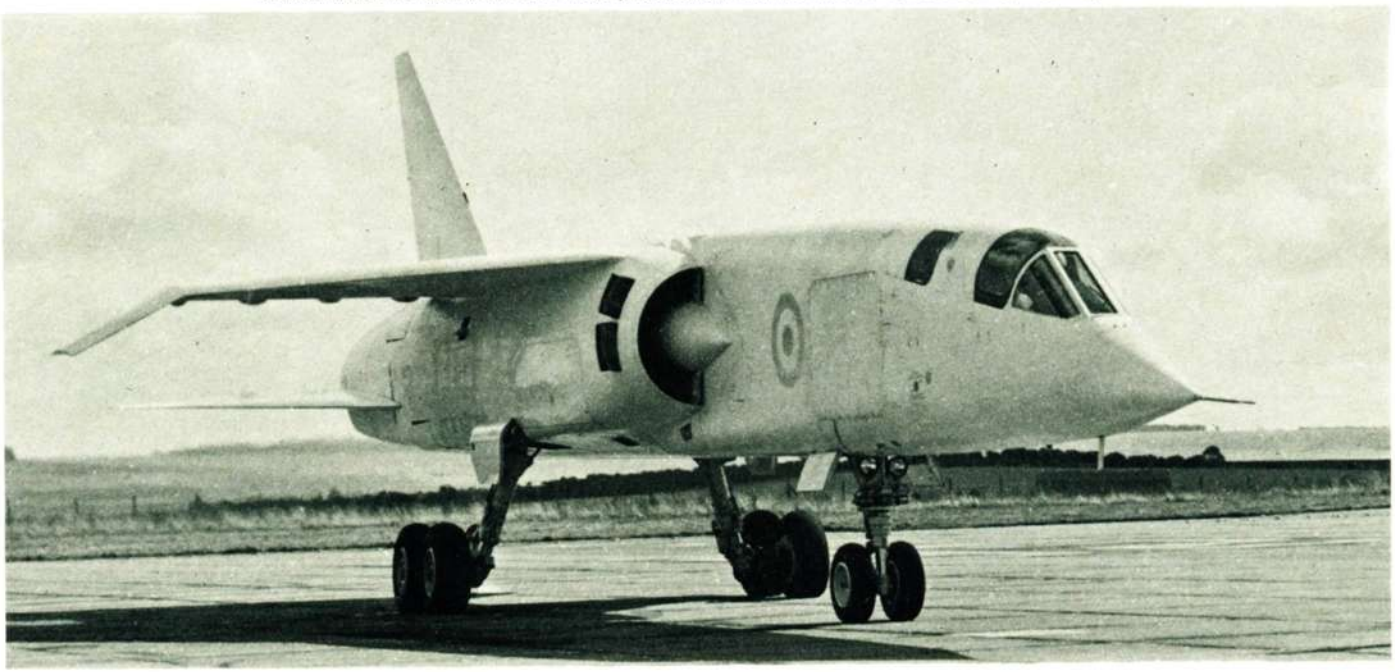


FROM its inception to the RAF's GOR 339 requirement the BAC TSR 2 tended to be regarded widely but erroneously as a form of military computer with a crew of two to monitor its progress. The error of this approach was countered at an early stage in the design work with the applied philosophy that this of all aircraft, with its critical flight regimes of contour flying at transonic speeds coupled with short field operating capability, needed essentially to have stability and control characteristics at least up to conventional standards and significantly better than previous standards at low level and high speed. The outcome of this design approach was the successful evolution of an outstandingly controllable, large and fast aircraft.

A typical test flight began with the rather prolonged check list drills which have since become common to the advanced avionics generation of military aircraft. With increasing familiarity, the drills on the TSR 2 could eventually be accomplished in about 20 minutes. The cockpit layout, designed for maximum convenience and accessibility, was enhanced by an unusually high level of comfort provided by the Martin-Baker Mk 8 rocket ejection seats, and these together provided the most comfortable military cockpit in our experience at that time.

While taxying, the CG was controlled to the briefing value by the fuel balancing system, this being crew-controlled in the prototype prior to introduction of the auto-balance system planned for production. Nosewheel steering was adequate, with fine and coarse gearings available, but pedal forces were on the heavy side and a combination of circuit friction and possible mechanical lost movement resulted in slight over-controlling which would have been corrected in the development programme. Even with derated development engines, this 100,000-lb (45400-kg) gross weight aeroplane showed a fighter-like rate of acceleration on take-off, and at VR the nosewheel was lifted with exactly matched stick movement/pitch response with no tendency to over or under-controlling,

The sole prototype of the TSR 2 to fly was XR219, depicted here, distinctive in its overall white finish as in use on the RAF's V-bombers at that time. For the low-level rôle, production aircraft would have been camouflaged.



the rotation continuing smoothly until reaching V_1. Typically, this occurred at 188 kts (348 km/h) at 12½ deg incidence and the long-stroke undercarriage action was so soft as to mask the unstick point, with mild airframe buffet in the undercarriage/flaps 20 deg configuration giving the only physical confirmation of take-off as the wheels broke ground.

From this point on, the inertia of this heavily-loaded aeroplane, coupled with its low gust response wing, made itself noticeable as an almost rigid, rock-steady "feel". With reheat cancelled and the last vestiges of mild buffet smoothed away by retraction of the undercarriage, and the engine roar reduced to a quiet hum at the Max Dry setting, the TSR 2 simply did not respond in the conventional way to gusts and turbulence. Flight at Mach 0·9 in the climb, at 500 to 600 kts (925 to 1 110 km/h) at low level, or through Mach 1·0 to supersonic speed at altitude all took place in an almost unreal calm which gave the crew an impression of being in a fixed-base simulator and not in free flight at all!

This rather extraordinary lack of response to the outside world was matched by smooth precision in control and in basic stability and damping (without stability augmentation on the first prototype) which gave further emphasis to the illusion. Even to pilots accustomed to the dramatic performance and fine controllability of the Lightning, the TSR 2 was impressive at low level, particularly as it scarcely responded to levels of turbulence which on more than one occasion caused the Lightning chase pilot to pull up to a higher level "to get out of the roughness". This rock steady behaviour made for rapid acquisition of confidence and pilots were soon able to contour-fly manually at Mach 0·9 over hill country in completely relaxed and comfortable conditions in which even flying in-trim stick-free at very low level was quite practical for short periods.

On the climb at Mach 0·9, speed stability was excellent and again the remarkable trim symmetry of this aircraft was apparent, with very little trim adjustment being needed from take-off to 30,000 ft (9150 m). The aircraft stayed on heading (at both high and low altitude) at the Mach 0·9 cruise condition without tendency to wander off and in the supersonic regime control characteristics were again exceptionally good, as illustrated by the reports at the time:

"Without auto stability in the first prototype, characteristics during 1*g* transition to supersonic flight at 30,000 ft (9150 m) were:

M=0·9 Vibration free. Control harmony satisfactory for continuous cruising without auto-stability. Lateral response perhaps a little too sensitive relative to the effects of inertia.

M=0·94 Onset of very slight buffet vibration. No trim change.

M=0·98 Cessation of any buffet vibration. No trim change. Lateral control sensitivity reduced.

M=1·02 No vibration. No trim change. PE jump as shock wave passed the static holes.

M=1·1+ No vibration or buffet. No trim change. Lateral control response in exact harmony with pitch and yaw axes and virtually ideal for flight conditions."

In manœuvring flight at transonic speed the low tailplane position was highly effective in maintaining longitudinal stability, and transition back to subsonic was made even in turns without any sign of the pitch-up characteristics normally encountered in any other supersonic aircraft of the period.

During preliminary handling in this area the position-error jump point (1·0 — 1·02 IMN) was encountered unexpectedly at 62 per cent of design maximum thrust and this, and subsequently the first deliberate acceleration through the transonic drag rise, gave immediate confidence in the performance potential. Later tests at low level and Mach 0·9 confirmed that in this specified main operating regime, performance was right on target.

From altitude, descent and instrument recovery characteristics were straight-forward and very pleasant due to the high directional and longitudinal stiffness with dead-beat damping coupled with excellent three-axis control harmony and the unusually high degree of speed stability. The confidence inspired by this aeroplane enabled us to investigate its first supersonic transition, its first cross-country flight (Boscombe Down to Warton) and its first weather penetration and instrument descent all on the same flight. No problems whatsoever were encountered in any of these aspects. A visual circuit pattern was entered and flown like any other supersonic aircraft in that speed was not lost easily in level flight and high induced-drag in the turn was an effective way of quickly reducing to undercarriage placard speed.

The highly loaded delta wing did not permit a dramatic level of manœuvrability in the clean configuration below 300 kts (555 km/h), where the buffet boundary was about 0·75*g* incremental, or in the

landing configuration where turning radii greater than with, say, a Lightning and similar to a Lockheed F-104 were achieved on base leg and finals.

In the landing configuration, longitudinal and directional stiffness and control harmony resulted in immediate feelings of security and confidence, and a 2 deg approach slope was flown with unusual ease due to the unexpectedly high speed stability which called for no throttle juggling even when well below the minimum drag speed at around 165 kts (305 km/h). On the approach, in fact, the TSR 2 proved as easy to fly as the best of the Mach 2·0 fighters.

Landings in the high lift configuration at 50 deg flap and with flap-blowing were very straightforward with pleasantly positive pitch control flaring to 14-15 deg incidence and resulting in a gentle touchdown and landing rolls of as little as 850 yards (778 m) without attempt to optimise either the approach speed or drag chute and braking techniques. The directional characteristics of this aircraft remained remarkable even on the ground, where no tendency to weather-cock with tail parachute under crosswind was noted. But it was with the undercarriage that the only serious development problem was encountered in the flight trials.

After various sequencing failures in retraction between flights three and nine, the undercarriage was finally retracted cleanly on flight 10, but from the very first flight onwards severe vibrations were experienced at touchdown, resulting from inter-action between the natural frequency of the undercarriage and that of the fuselage, registering brief peaks of about +1·8*g* at 5 cycles per sec at the cockpit, which was a disturbing experience for the crew. There were also indications that the spring rate of the main legs was not well matched to the landing loads as a tendency to rebound strongly occurred, and on flight 11 this led to a very heavy landing and some undercarriage damage. It said much for the precise controllability of the aircraft, and of the impression made by this incident, that many subsequent landings were measured at less than 1 ft/sec (0,3 m/sec) descent! But resolution of these problems was well on the way by the time of the aircraft's cancellation.

The Bristol Siddeley Olympus 22R engine was in a very critical stage of development, having encountered a number of catastrophic failures in the test chamber caused by failure of the LP compressor shaft, but throughout the short flying programme of 23 flights, control of the engine in TSR 2 was entirely satisfactory in all the conditions tested within the existing rather severe engine limitations, and reheat ignition and functioning was never faulted.

TSR 2 was a brilliantly successful pilot's aeroplane which, at the time of cancellation, had already demonstrated successful confirmation of its most significant aerodynamic and engineering features, and had in parallel reached a point of similar success in the developing and testing of its advanced navigation/attack and reconnaissance avionic systems. It seemed well set to achieve all the targets of its stated operational rôle and in the process to set new standards of precise controllability which have not been surpassed, or perhaps even equalled, to this day. □

BAC TSR 2 Specification

(As at November 1962)

Power Plant: Two Bristol-Siddeley Olympus 22R Mk 320 twin-spool axial flow turbojets with water injection and variable reheat, rated at 19,600 lb st (8 898 kgp) dry and 30,610 lb st (13 897 kgp) with full reheat in ISA at sea level. Total usable internal fuel capacity, 5,588 Imp gal (25 400 l), comprising 1,474 Imp gal (6 700 l) in two wing tanks, 2,255 Imp gal (10 250 l) in two forward fuselage tanks, 1,900 Imp gal (8 637 l) in two aft fuselage tanks and 59 Imp gal (268 l) in forward and aft collector boxes. Provision for in-flight refuelling at 400 Imp gal (1 818 l) per min. Provision for 570 Imp gal (2 590 l) in non-jettisonable weapons bay tank, two 450-Imp gal (2 045-l) wing drop tanks and 1,000-Imp gal (4 546-l) ventral drop tank.

Performance: Max cruising speeds, Mach=0·9 to 1·1 at 200 ft (61 m), Mach=2·05 above 36,000 ft (10 980 m), equivalent to a VNO of 725 kt (1 342 km/h) IAS; max design speed (VD) 800 kts (1 480 km/h)/Mach=2·25; initial ratio of climb, over 50,000 ft/min (254 m/sec); max operating altitude, 54,000 ft (16 470 m); take-off ground roll (Max take-off weight), 3,000 ft (915 m); landing ground roll (with brake parachute), 1,500 ft (457 m); radius of action with one 2,000 lb (908 kg) bomb internally, 1,150 mls (1 850 km) with 10 per cent at Mach=1·7 above 40,000 ft (12 200 m) and 20 per cent at Mach=0·9 at 200 ft (61 m), or 575 mls (925 km) at Mach=2·0 at medium altitude or 800 mls (1 286 km) at Mach=0·9 at 200 ft (61 m); radius of action with wing drop tanks, 1,725 mls (2 774 km); ferry range, up to 4,250 mls (6 850 km).

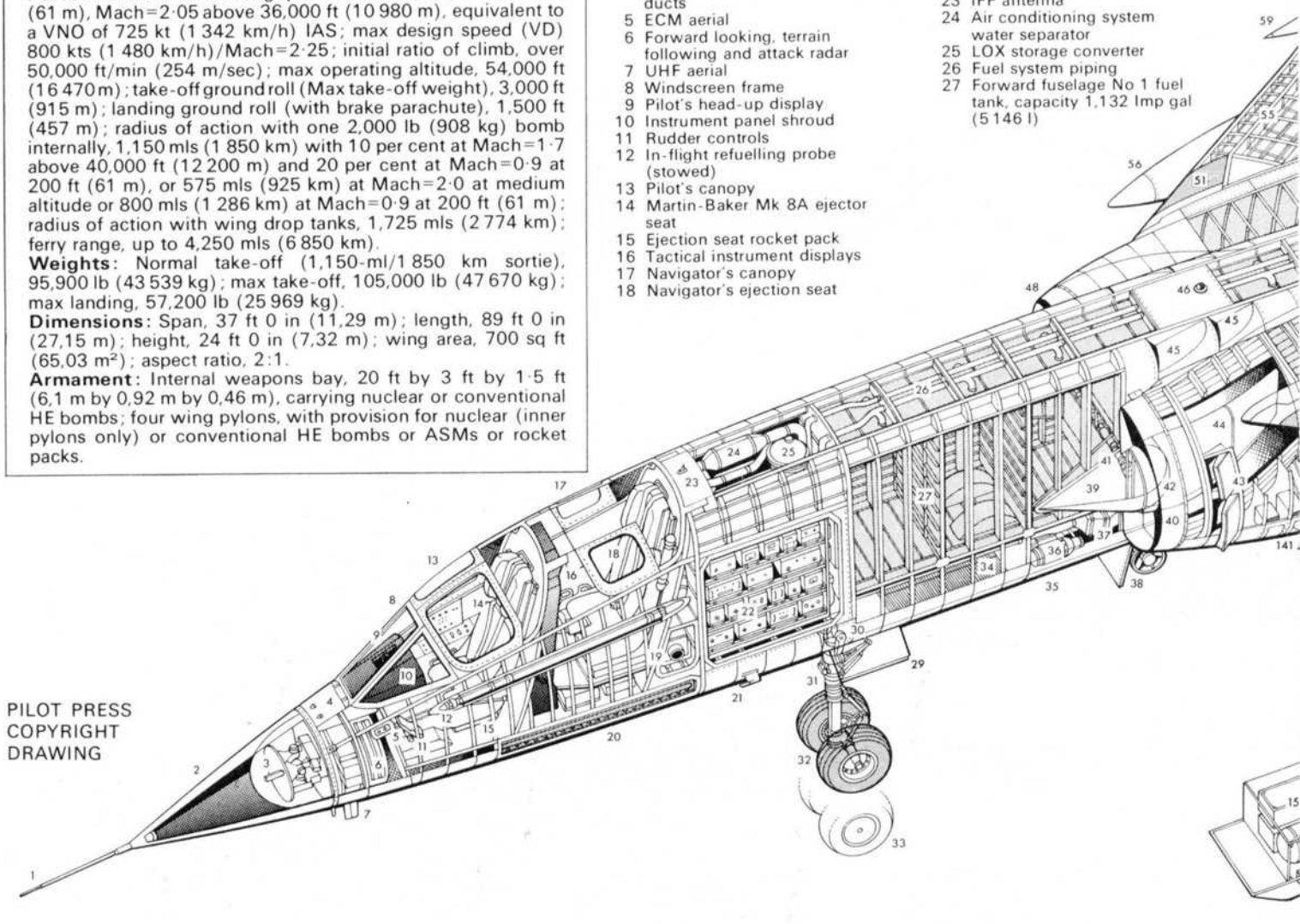
Weights: Normal take-off (1,150-ml/1 850 km sortie), 95,900 lb (43 539 kg); max take-off, 105,000 lb (47 670 kg); max landing, 57,200 lb (25 969 kg).

Dimensions: Span, 37 ft 0 in (11,29 m); length, 89 ft 0 in (27,15 m); height, 24 ft 0 in (7,32 m); wing area, 700 sq ft (65,03 m²); aspect ratio, 2:1.

Armament: Internal weapons bay, 20 ft by 3 ft by 1·5 ft (6,1 m by 0,92 m by 0,46 m), carrying nuclear or conventional HE bombs; four wing pylons, with provision for nuclear (inner pylons only) or conventional HE bombs or ASMs or rocket packs.

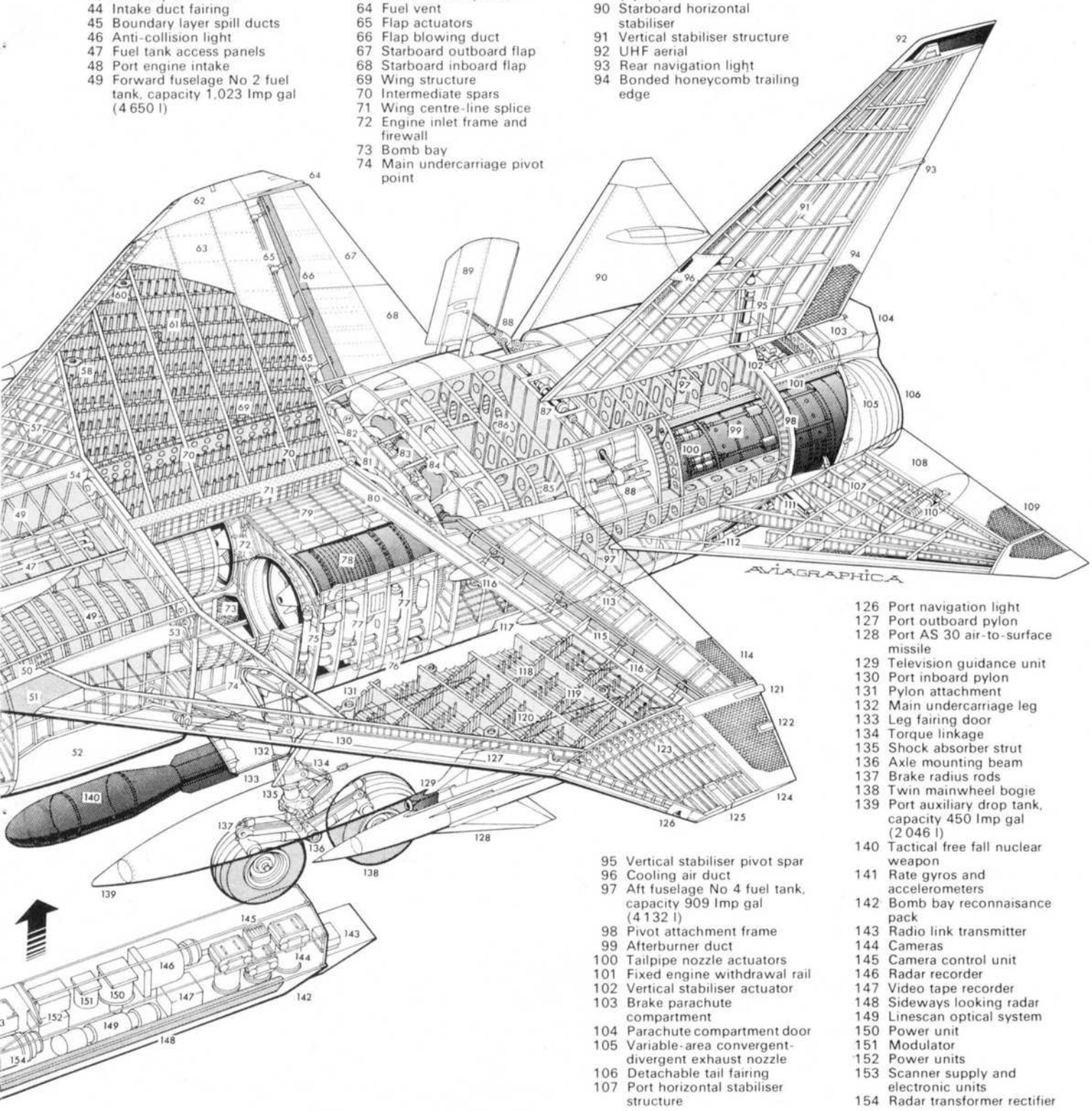
BAC TSR 2 Cutaway Drawing Key

1 Pitot head
2 Radome
3 Radar scanner
4 Windscreen rain repelling ducts
5 ECM aerial
6 Forward looking, terrain following and attack radar
7 UHF aerial
8 Windscreen frame
9 Pilot's head-up display
10 Instrument panel shroud
11 Rudder controls
12 In-flight refuelling probe (stowed)
13 Pilot's canopy
14 Martin-Baker Mk 8A ejector seat
15 Ejection seat rocket pack
16 Tactical instrument displays
17 Navigator's canopy
18 Navigator's ejection seat
19 Oblique camera
20 Sideways looking radar
21 Stand-by pitot head
22 Avionics equipment bay
23 IFF antenna
24 Air conditioning system water separator
25 LOX storage converter
26 Fuel system piping
27 Forward fuselage No 1 fuel tank, capacity 1,132 Imp gal (5 146 l)



PILOT PRESS COPYRIGHT DRAWING

28 Nosewheel well
29 Nosewheel door
30 Extending nosewheel leg
31 Shock absorber strut
32 Twin nosewheels
33 Nosewheel extended position (take off)
34 Pre-closing nosewheel doors
35 Doppler navigation aerial
36 Emergency generator
37 Air conditioning heat exchanger
38 Airborne auxiliary power unit (lowered)
39 Intake moveable centre body, half cone
40 Port engine intakes
41 Centre-body jack
42 Centre-body boundary layer bleed duct
43 Auxiliary air intakes
44 Intake duct fairing
45 Boundary layer spill ducts
46 Anti-collision light
47 Fuel tank access panels
48 Port engine intake
49 Forward fuselage No 2 fuel tank, capacity 1,023 Imp gal (4 650 l)
50 Wing/fuselage leading edge spar attachment
51 HF notch aerial
52 Main undercarriage doors
53 Wing/fuselage attachment frame forging
54 Front spar attachment
55 Leading edge structure
56 Starboard auxiliary drop tank, capacity 450 Imp gal (2 046 l)
57 Fuel pipes in leading edge
58 Inboard pylon fitting
59 Starboard AS 30 air-to-ground missile
60 Outboard pylon fitting
61 Starboard wing integral fuel tank, capacity 737 Imp gal (3 350 l)
62 Starboard anhedral wingtip
63 Machine skin panels
64 Fuel vent
65 Flap actuators
66 Flap blowing duct
67 Starboard outboard flap
68 Starboard inboard flap
69 Wing structure
70 Intermediate spars
71 Wing centre-line splice
72 Engine inlet frame and firewall
73 Bomb bay
74 Main undercarriage pivot point
75 Retraction jack
76 Engine accessory gearbox
77 Hydraulic reservoirs
78 Bristol Siddeley Olympus 22R turbojet
79 Water injection tank, capacity 80 Imp gal (364 l)
80 Rear spar
81 Wing fuel system piping
82 Wing/fuselage aft attaching frame
83 Flap gearbox and hydraulic motors
84 Bleed air ducting
85 Engine tunnel duct
86 Aft fuselage No 3 fuel tank, capacity 991 Imp gal (4 505 l)
87 Airbrake hydraulic motor
88 Airbrake screw-jack
89 Starboard upper airbrake (open)
90 Starboard horizontal stabiliser
91 Vertical stabiliser structure
92 UHF aerial
93 Rear navigation light
94 Bonded honeycomb trailing edge
108 Stabiliser flap
109 Honeycomb structure
110 Stabiliser flap actuator
111 Pivot spar
112 Horizontal stabiliser actuator
113 Port flaps
114 Honeycomb trailing edge structure
115 Flap blowing air duct
116 Flap actuator fairings
117 Port lower airbrakes
118 Port wing integral fuel tank, capacity 737 Imp gal (3 350 l)
119 Wing structure
120 Skin support posts
121 Fuel vent
122 ECM aerial
123 Wingtip structure
124 Port anhedral wingtip
125 ILS aerial



126 Port navigation light
127 Port outboard pylon
128 Port AS 30 air-to-surface missile
129 Television guidance unit
130 Port inboard pylon
131 Pylon attachment
132 Main undercarriage leg
133 Leg fairing door
134 Torque linkage
135 Shock absorber strut
136 Axle mounting beam
137 Brake radius rods
138 Twin mainwheel bogie
139 Port auxiliary drop tank, capacity 450 Imp gal (2 046 l)
140 Tactical free fall nuclear weapon
141 Rate gyros and accelerometers
142 Bomb bay reconnaisance pack
143 Radio link transmitter
144 Cameras
145 Camera control unit
146 Radar recorder
147 Video tape recorder
148 Sideways looking radar
149 Linescan optical system
150 Power unit
151 Modulator
152 Power units
153 Scanner supply and electronic units
154 Radar transformer rectifier
95 Vertical stabiliser pivot spar
96 Cooling air duct
97 Aft fuselage No 4 fuel tank, capacity 909 Imp gal (4 132 l)
98 Pivot attachment frame
99 Afterburner duct
100 Tailpipe nozzle actuators
101 Fixed engine withdrawal rail
102 Vertical stabiliser actuator
103 Brake parachute compartment
104 Parachute compartment door
105 Variable-area convergent-divergent exhaust nozzle
106 Detachable tail fairing
107 Port horizontal stabiliser structure

Photograph by Arthur Gibson

Wherever it is,
whenever it happens,
there's always a newspaper
to give it to you first -

DAILY EXPRESS

BIGGIN HILL'S THOUSANDTH KILL

BY W J A WOOD

BY ANY STANDARD it was a remarkable achievement — the 1,000th enemy aircraft to be destroyed in combat by Royal Air Force, Commonwealth, Dominion and Free French fighter squadrons operating from Biggin Hill, the legendary key Sector Station of No 11 Group, RAF Fighter Command, since the start of WW II in September 1939. It happened within the space of a few dramatic, explosive seconds in the clear skies over Caen, in Normandy, on the afternoon of Saturday, 15 May 1943.

It happened without fanfare or fuss. There was none of the chivalrous jousting that has been attributed, albeit mistakenly, to the aerial combats of the First World War — just a brief crash of Hispano 404 Mk II cannon aimed with the correct deflection for their 20-mm shells to bring about, with horrifying efficiency, the abrupt sectional dismemberment of a wildly turning Focke-Wulf Fw 190A-4. By 1943, fighter-versus-fighter combat had become virtually a science; the formula for success dictated by strict tactical discipline, the use of radar control and surprise. But this success was constantly in the balance; the rewards of one day could be transformed into disaster on the next by a mistimed turn, injudicious use of the sun, or a moment's hesitation. All fighter pilots, no matter how great their experience, lived in fear of the surprise attack — the dreaded "bounce" that came without warning before the first tracers flashed over the canopy followed, as often as not, by the reverberating, splintering crash of a 20-mm shell strike. Then discipline and order were thrown to the winds, panic came close to even the veteran and the urge for survival motivated every action.

Through survival came expertise and after three years of almost continuous combat operations on the Channel Front, the surviving fighter pilots of RAF Fighter Command and those of the *Luftwaffe* based in Northern France now shared expertise to an unparalleled degree. In May 1943, the residing fighter units based at Biggin Hill were Nos 341 *Alsace* and 611 (West Lancashire) Squadrons, the former manned by French personnel and commanded by Cmdt R G O J Mouchotte, DFC, and the latter (originally an RAuxAF unit) by RAF pilots led by Sqn Ldr E F J Charles, DFC. The Station Commander was the surviving top-scoring pilot of Fighter Command, the brilliant and popular South African Gp Capt A G Malan, DSO and Bar, DFC and Bar, whose rank and position did not prevent him from regularly participating in combat operations. Under him and responsible for the efficient running of the Wing was Wg Cdr A C Deere, DFC and Bar, now on his fourth fighter tour, whose skill and imagination fostered a new aggressive spirit in the Biggin Hill Wing before his tenure was brought to a premature end by ill health in July 1943.

Malan, Deere, Charles and Rene Mouchotte were only a part of a fighting organisation which, while maintaining a high defensive commitment, had been on the offensive since the summer of 1941. The "Battle of Britain" had been followed by a period of conservation for RAF Fighter Command, now led by Air Marshal Sholto Douglas, before the start of a massive day offensive against the *Luftwaffe* based in Northern France. It was during February 1941 that RAF Fighter Command adopted the Wing system, the first two being the

(Below) Sqn Ldr E F J "Jack" Charles, DFC, shakes hands with Cmdt Rene Mouchotte following their joint successes on 15 May 1943. They are flanked by Sqn Ldr de la Torre and Wg Cdr Alan Deere. In the heading picture, Sqn Ldr Charles records the 1,000th Biggin Hill victory on his Spitfire IX.

Ferranti. On target since 1943.

Ferranti have been associated with the RAF especially since the action-packed days of World War II when our Edinburgh factory was set up to manufacture gyro gunsights for a variety of contemporary aircraft from the Lancaster to the Typhoon.

The ISIS weapon aiming system we are currently supplying for the Hawk is a recognisable descendant of these early sights.

But of course there are many other systems Ferranti are making for the RAF and allied air forces.

Our Inertial Navigation/Attack System (INAS) has proved a major success with Harrier and Phantom. A more advanced version still – our Digital Inertial Navigation System – has been chosen for MRCA and Nimrod Mk. II.

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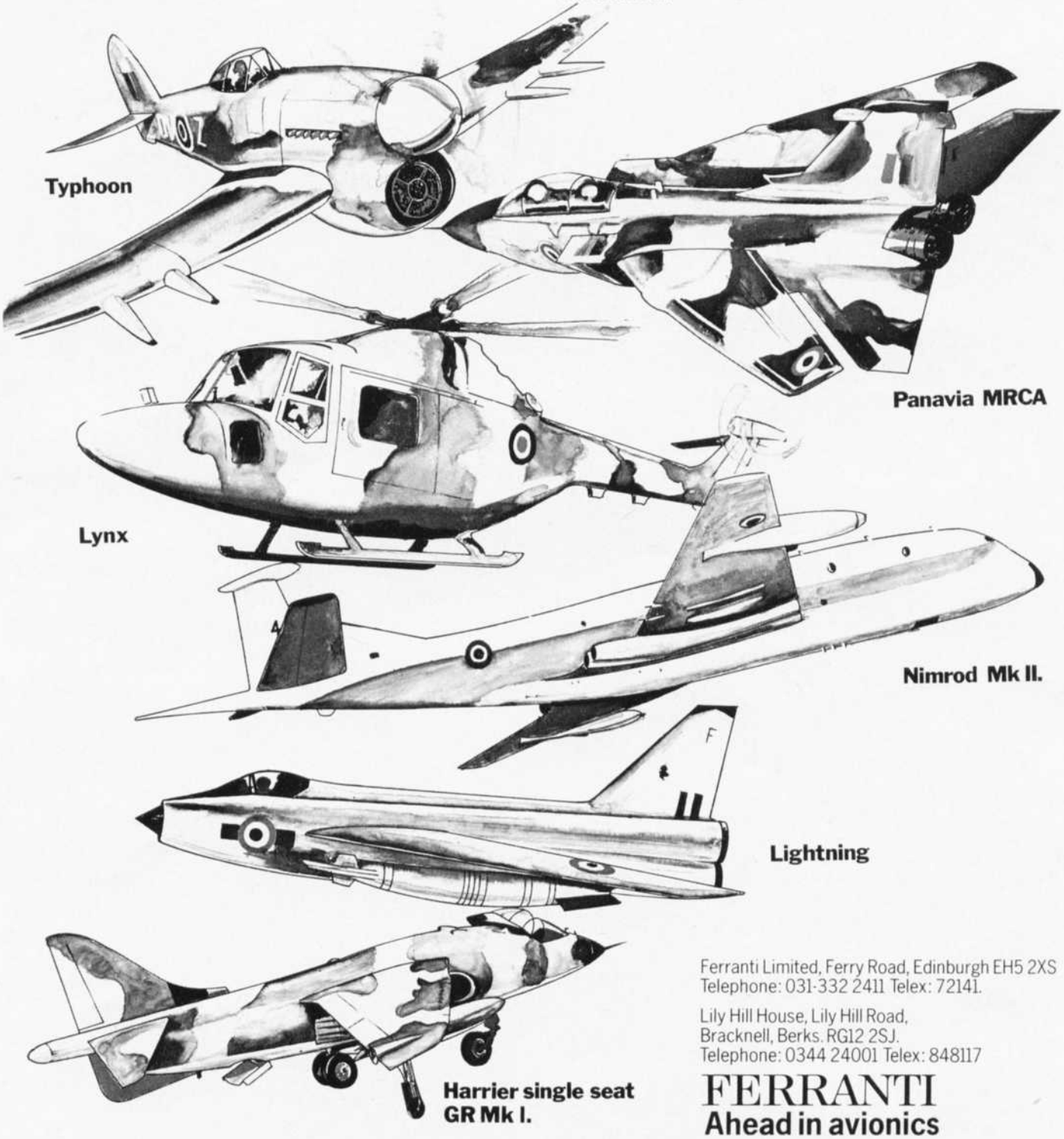

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Biggin Hill and Tangmere Wings led by Wg Cdr A G Malan and Wg Cdr D R S Bader respectively. Made up of three or four squadrons, the Wing was largely a copy of the *Gruppe* organisation of the *Luftwaffe*, and while the Wing system had proved too unwieldy for defensive operations during the "Battle", it was now considered ideal for operations in enemy airspace where numerical inferiority would be at best a grave disadvantage and at worst suicidal.

When RAF Fighter Command's day offensive started on 14 June 1941, Air Vice Marshal Leigh-Mallory's No 11 Group, which spearheaded the offensive, consisted of the Biggin Hill, Tangmere, Kenley, Northolt, Hornchurch and North Weald Wings, while others, both within No 11 Group and neighbouring Nos 10 and 12 Groups, were in the process of formation. Their task appeared simple: the achievement of air superiority over Northern France in face of an enemy whose fighter force, by dint of the massive redeployment by the *Luftwaffe* against Russia, stood at only two *Geschwader*. Technically, both sides were well matched, with the performance of the new Messerschmitt Bf 109F-2 being on a par with that of the then latest Spitfire variant, the Mk VB. Although initially it was Leigh-Mallory's fighter squadrons that took the initiative, the limited range of the Spitfire plus the growing efficiency of the *Luftwaffe* fighter control organisation in France led to a hard fought reversal in August 1941, in which Fighter Command, despite the high combat claims of its squadrons, was losing far more pilots than was the *Luftwaffe*. The Biggin Hill Wing, consisting of Nos 74, 92 and 609 Squadrons, fought hard throughout the summer offensive, and it was in July that its then Wing Leader, Wg Cdr Malan, raised his score to 32 enemy aircraft destroyed.

Fighter Command ceased regular offensive operations in mid-October, but maintained a high level of fighter sweeps throughout the winter before resuming the offensive in March 1942. The scene, however, had changed to its disadvantage, for, despite the numerical inferiority of the *Jagdruppen* based in Northern France, re-equipment of these units with the new Focke-Wulf Fw 190A-1 had continued apace. Such was the superiority of Kurt Tank's radial-engined fighter over the Spitfire Mk V that within weeks of the new offensive, Fighter Command's operations were restricted to short penetrations of enemy airspace, with high casualties — out of all proportion to gain — being sustained against "long-range" targets such as Lille, Comines and Bethune.

Having already lost one Wing Leader in January 1942, the Biggin Hill Wing suffered a further blow on 10 April 1942, when Wg Cdr Michael Lister-Robinson, DSO, DFC, was killed in combat with II/JG 26 off Le Touquet. His successor was Wg Cdr J E Rankin DFC, and it was during his tenure that the first Spitfire Mk IXs arrived at Biggin Hill when No 401 RCAF Squadron received the type during August. Powered by the Rolls-Royce Merlin 61 engine incorporating a two-speed two-stage supercharger that boosted power output, particularly at altitude, the Mk IX's arrival on the Channel Front, albeit in small numbers, went a long way in countering the potency of the by then current Fw 190A-3s and the high-altitude Bf 109G-1s which were entering service with the *Luftwaffe* at this time.

Fighter Command found renewed impetus for its offensive operations with the start, in August 1942, of the US 8th Air Force's daylight raids on targets in France, but the range problem loomed as large as ever, and despite the use of 30 Imp Gal (136 l) external tanks, the combat radius of the Spitfire, and thus the fighter cover for the B-17s and B-24s, extended only as far as the line Brussels-Lille-Beavais-Rouen. Beyond that line the American heavies were on their own. The Autumn of 1942 saw the Biggin Hill Wing (Nos 340 and 611 Sqdns) engaged in "Rodeos" (fighter sweeps), and a variety of escort and support rôles for the 8th Air Force against the marauding Fw 190s of JG 2 and JG 26.

After the German invasion of the Soviet Union on 22 June 1941, two fighter units — *Jagdgeschwader* 2 (JG 2) *"Richthofen"* and *Jagdgeschwader* 26 (JG 26) *"Schlageter"* — had remained in the West, being entrusted with the air defence of an area which stretched from the Scheldt Estuary to Brest. Their numbers never rose above a total of 240 aircraft, but despite this numerical inferiority they conducted their task with economy and efficiency. By the winter of 1942, however, the tide of German fortunes was on the turn, and in particular the *Luftwaffe* was faced by commitments in the Soviet Union and the Mediterranean wherein all the latent shortcomings in its strategical planning were brought to fruition. Fighter Command's opponents in Northern France suffered serious depletion: in November 1942 four *Staffeln* of JG 2 (II/JG 2 and 11./JG 2) were sent to Tunisia, while JG 26 was forced to despatch I/JG 26 and 7./JG 26 to the Soviet Union in January 1943 — all this at a time when 8th Air Force operations in the West were gaining momentum.

By May 1943, *Luftflotte* 3, the organisation responsible for the

Oberleutnant Horst Hannig, Staffelkapitan of 2./JG 2, briefs his pilots before a mission from Triqueville. His Focke-Wulf Fw 190A-4 in the background is depicted in colour on page 63.

These two Spitfires were among the losses suffered by the Biggin Hill squadrons in the weeks of fighting leading up to the 1,000th victory. The Mk IX BS244 (upper) failed to return on 13 February 1943 while being flown by Cmdt J Schloesing, OC of No 340 Squadron, who was shot down by Fw 190s of II/JG 26 over Le Touquet. The Mk IX BS435 was lost on 5 February 1943 while being flown by Sqdn Ldr Hugh T Armstrong, DFC and Bar, OC of No 611 Squadron, who fell to the guns of Uffz Heinz Gomann of 5./JG 26 near Boulogne.

air defence of France and Belgium, could muster only 280 Bf 109G-4s, G-6s and Fw 190A-4s (of which 75 per cent were usually serviceable) to thwart the depredations of 8th Air Force B-17s and B-26s, and of the Mitchells, Bostons and Venturas of No 2 Group, RAF Bomber Command. However, the shortcomings of the *Luftwaffe* training organisation had not yet taken effect and the pilots of JG 2 and JG 26, including a considerable nucleus of veterans who had seen more than three years of combat experience, were generally of a very high operational standard. They were cunning, aggressive and fought hard when the initiative was in their hands; their equipment, the Fw 190A-4, was second to none and they were backed by an efficient ground control system. They were still a very formidable force.

The *"Richthofen" Geschwader* was commanded by Obstlt Walter Oesau, a shadowy figure with a brilliant combat record who now seldom flew on active operations, preferring to run his outfit from the regal splendour of his quarters at Beaumont-le-Roger. His subordinates, however, were all experienced fighter leaders with a considerable number of "kills" to their credit. In May 1943, *Jagdgeschwader* 2 was deployed to the West of the river Seine: I/JG 2, under Major Helmut-Felix Bolz, was based at Triqueville, II/JG 2, under Hptm Kurt Bühligen, was recuperating after its drubbing in Tunisia and III/JG 2, led by the redoubtable Hptm Egon Mayer, was stationed at Vannes and Evreux-Fauville. The principal antagonists of Alan Deere's Biggin Hill Wing were the Messerschmitts and Focke-Wulfs of JG 26. This unit was based in the Lille area, and was commanded by the brilliant and flamboyant Major Josef "Pips" Priller. Unlike Oesau, this stocky little pilot flew regularly from his base at Lille-Vendeville at the head of his *Geschwader*. All Priller's victories had been gained on the Western Front in combat operations stretching as far back as the Dunkirk fighting of May 1940. Now, three years later, as *Geschwader Kommodore* and winner of the coveted Oak Leaves to the Knight's Cross, he had raised his formidable score to 87. The way in which the *Luftwaffe* employed its combat pilots goes a long way towards explaining this amazing score. There were no operational tours as such in the *Luftwaffe*; a German fighter pilot was entitled to four weeks furlough per annum and he flew hard until he was either killed or badly wounded. The remainder of Priller's unit was stationed nearby, with II/JG 26 based at Vitry-en-Artois, near Douai, and III/JG 26 at Wevelghem, on the Franco-Belgian border.

The Biggin Hill Wing had several old scores to settle with JG 26 and, in particular, with II/JG 26, now commanded by Hptm Wilhelm-Ferdinand Galland, the brother of Adolf Galland, the General of Fighters. This *Gruppe* had frequently tangled with the Biggin Hill Wing over France and the Channel. On 5 February 1943, while chasing some Fw 190 fighter-bombers which had just attacked Hailsham, a section of No 611 Squadron was ensnared by escorting Focke-Wulfs of II/JG 26 over the Channel and the Squadron's popular CO was shot down and killed. A few days later, on 13 February, the Wing again suffered losses at the hands of II/JG 26. Thirty of Galland's Fw 190s forced the Wing into a bitter rearguard action off Le Touquet, shooting down Cmdt Schloesing of the Free French No 340 Squadron. Another mauling took place just over one month later, on 14 March. In a vicious battle off Berck-sur-Mer at 1750 hours, Galland's 190s despatched the Wing Commander Flying, Wg Cdr R M Milne, DFC, Cmdt Reilhac of No 340 Squadron, and a supernumerary, Wg Cdr J Slater. Although over-claiming, the *Gruppe* inflicted heavy losses on the Wing without casualties to itself.

Shortly after this last incident, No 340 Squadron was pulled out of operations, its place being taken by Cmdt Rene Mouchotte's No 341 *Alsace* Squadron. In the meantime No 611 Squadron, now under Wag Haw, got a morale raiser with the arrival of the latest Spitfire Mk IXs powered by the Merlin 66 engine. This engine, a variant of the Mk 61, produced 1,560 hp at 3,000 rpm and +18 lbs/sq in (1,27 kg/cm²) boost pressure within the medium altitude band wherein, up to now, the Focke-Wulf 190 had remained omnipotent.

After completing his ground tour in No 13 Group, Wg Cdr Alan Deere was posted south as OC Kenley Wing, but his posting coincided with the loss of Wg Cdr Milne, and on Gp Capt Malan's request, Deere was switched to lead the Biggin Hill Wing, while Wg Cdr J E Johnson took command of the Kenley squadrons. For Deere, the posting as Wing Leader was the realisation of his ambition and he was determined to implement his theories on Wing tactics now that the opportunity had finally arisen. While being responsible for routes and timing when leading the Wing, Deere wanted his squadrons and sections to exercise an unprecedented element of initiative and independence, thereby achieving a more profitable and flexible form of attack. The mass-controlled Wing tactics of old were to be abolished and replaced by more fluid tactics while still maintaining mutual support and discipline. One of his stipulations was that whatever the escort rôle of the Wing, on no account was the speed of his Spitfires to be tied to that of the bombers. The accepted tactic of flying alongside the bombers gave the bomber pilots some measure of comfort but no real protection. These were but a few of the revised tactics that Deere

put into effect within weeks of taking over the Biggin Hill Wing, and in the bloody fighting of the Summer of 1943, these aggressive stratagems were to harvest rich dividends.

One of Deere's first operations as Wing Leader, which illustrated his flexible and daring approach, was an attempt to catch I/JG 2 taking-off and assembling over Triqueville. On the evening of 17 April, while Caen was raided by Bostons of No 2 Group, Deere led 341 and 611 Squadrons in a low level attack on the airfield. They were only seconds too late in jumping the Fw 190s as they raced across the airfield, and a spirited low-level dogfight ensued over the heads of the astonished ground crews. The results were disappointing — two Spitfires lost for no claims — but the operation undoubtedly caused considerable alarm to the *"Richthofen"* pilots.

When Deere took over the Biggin Hill Wing, 17 more "kills" were needed to bring the total to 1,000 destroyed by pilots operating from the station. Even as early as March, the event was eagerly awaited by all ranks at Biggin Hill and no less by the British Press. By the end of April the total stood at 990. On 4 May 1943, the Biggin Hill Wing flew as 2nd Fighter Cover in support of seventy-nine B-17s raiding the Matford works at Antwerp on Ramrod 68. Over Walcheren, the Wing met elements of JG 26 led by "Pips" Priller, and in the sparring that ensued Wg Cdr Deere shot down a Fw 190 to bring the Wing's total to 995. Bad weather then intervened and it was not until 14 May that the Wing was again in action. This time they acted as 3rd Fighter Cover on Ramrod 73 to III/JG 26's home-base at Courtrai-Wevelghem. The bombing was excellent, forcing Hptm Ruppert's III *Gruppe* to quit Wevelghem for Lille-Nord on the following day, but this was achieved only after a tough battle in which two Fortresses and one Spitfire (Sgt Clarke of No 611 Sqdn, who collided with a Bf 109G) were lost. Of the total No 11 Group claims — seven destroyed, one probable and four damaged — the Biggin Hill Wing shot down two Fw 190s and one Bf 109G, bringing the score to 998. One of the Fw 190s to go down was flown by the *Staffelkapitän* of 8./JG 26, Hptm Karl Borris, who broke both ankles after a traumatic bale-out at 1,600 feet (500 m) near Wevelghem.

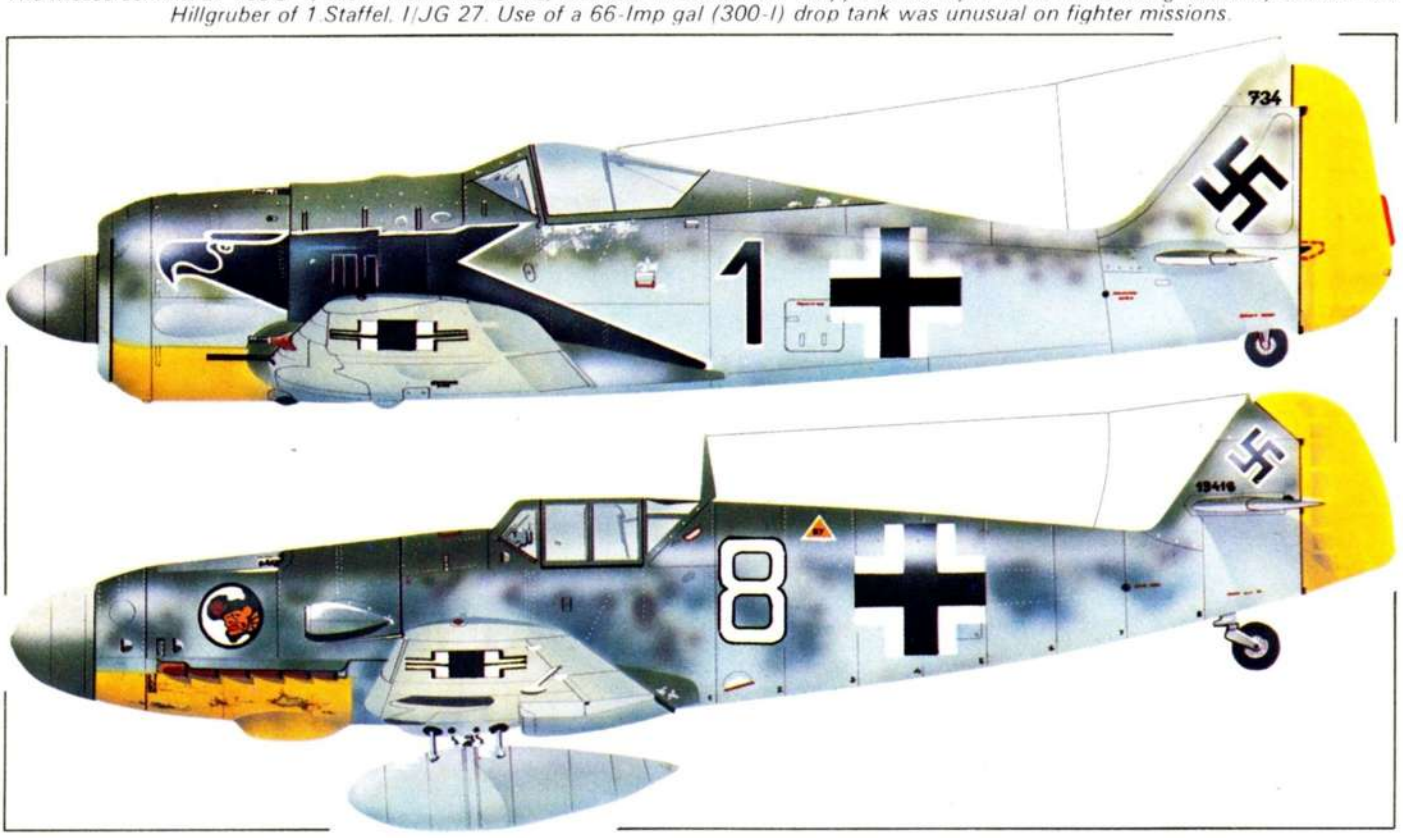
All pilots at Biggin Hill were now gripped by a feverish intensity; leave was out of the question and those left off the duty roster for operations expressed their disappointment forcefully. Apart from the kudos of being the fortunate pilot to claim the 1,000th "kill" there was the added attraction of a £300 cash prize, raised through a mammoth raffle which had been underway for the past six months.

The weather over Northern France was fine on 15 May, and with Circus 297 planned for the afternoon, the probability of Biggin's 1,000th looked good. The Circus (an operation aimed solely at effecting *Luftwaffe* fighter reaction) was in two parts, to be operated simultaneously. The Biggin Wing was earmarked for Part I as Fighter Echelon in which six Mitchells of No 2 Group were to bomb the airfield at Caen-Carpiquet, a base frequented by the *"Richthofen" Jagdgeschwader*. This airfield was also to be subjected to a follow-up attack by twelve Typhoon fighter-bombers of No 181 Squadron as soon as the smoke of the first attack had cleared. Four Spitfire Wings were to furnish escort and support, and tangles with JG 2 seemed likely. Part II of Circus 297 would consist of an attack on Poix airfield by 12 Bostons of No 2 Group, escorted and supported by five Spitfire Wings. Over forty Messerschmitt Bf 109Gs had recently been spotted at Poix by the watchful camera lenses of RAF photographic reconnaissance units, and these — belonging to I/JG 27 and 11./JG 2 — would surely be in the air to meet the attack.

At 1621 hours, the first of 26 Spitfire IXs of Nos 341 and 611 Squadrons, including Wg Cdr Deere and Gp Capt A G Malan, bounced across Biggin Hill's uneven turf and snarled into the air. Minutes later, flying just above the trees, the Wing breasted Shoreham-by-Sea and eased down to sea level, well below the prying eyes of the German *Freya* radar. At 1641 hours, Deere opened up and pulled the Wing into a steep climb, while elsewhere, hidden in the Channel haze, the Bostons, Mitchells and Spitfires gunned their throttles and gained height. Surprise was now over. The pilots could hear the crackle of enemy radio interference in their headphones, and then their own R/T silence was broken as the No 11 Group controllers warned them of enemy fighter pilots: the Poix Messerschmitts already airborne and gaining height towards Amiens . . . 20 plus climbing towards Rouen . . . a further 15 plus orbiting Lisieux.

Over Trouville, on the French coast, the Biggin Hill Wing levelled off at 21,000 ft (6400 m) and, throttling back to maximum continuous cruise, headed south for their turning point — the small town of Bonnebosq, nestling far below in the orchards and bocage of Normandy. All pilots were keyed to an intense altertness. Above No 611 Squadron, Mouchotte's *Alsace* squadron fanned out into tactical fours and within the cockpits of the Spitfires the pilots continually scanned the sky, occasionally darting a swift glance at

Two Luftwaffe losses in the intensive fighting of Spring 1943 are depicted here. The Focke-Wulf Fw 190A-4, Werk-Nummer 734, was being flown by Oberleutnant Horst Hannig, Staffelkapitän of 2./JG 2, when he was shot down by Sqdn Ldr Jack Charles on 15 May 1943. The black stylised eagle insignia used on many JG 2 aircraft served to obscure the untidy trail of oil stains and oxide gas left by the exhaust. The Messerschmitt Bf 109G-4, Werk-Nummer 19418, was lost in combat off Dieppe on 17 April 1943 while being flown by Obfw Ernst Hillgruber of 1 Staffel, I/JG 27. Use of a 66-Imp gal (300-l) drop tank was unusual on fighter missions.



the tell-tale temperatures, pressures and engine indications. Weapons were cocked and ready, with gunsights adjusted for combat.

Over Bonnebosq, the Wing entered an easy turn to the west, heading towards Caen. Then there were the first nasal shouts, warnings and oaths that presaged an engagement . . .

"Snowball Red calling, watch out for Huns at seven o'clock high."

"Close up Filmstar aircraft, Focke-Wulfs at two o'clock level!"

"Watch out for those bastards above you, Snowball Yellow!"

The first enemy attack came when nine Fw 190s of I/JG 2 attacked the Northolt Wing (Nos 315 and 316 Sqdns) flying as High Cover, just as the Mitchells released their bombs over Carpiquet and went into a tight turn. The turn was, in fact, so sudden that several of the escorting Spitfires were thrown out of position and straggled behind their precious charges. This was just what the Focke-Wulf leader had been awaiting — the split second's lack of cohesion that offered the opportunity for an attack. Down they came. The glint of sun on the polished canopies and wings as they peeled off, yellow cowlings and stark black and white crosses on pale blue undersides standing out clearly as each Focke-Wulf, leaving a thin trail of exhaust smoke, dived in, stubby wings waggling nervously, at over 450 mph (725 km/h)

"Here they come, Filmstars! One-eighty port, go!"

"Tighten it up, George! There's one turning in your six o'clock!"

The combat took place between the airfield and the coast. The Polish Wing bore the first brunt of the Focke-Wulf's attack, and before the Wing could recover its equilibrium after the first pass, Gp Capt Pawlikowski and Sgt Lewandowski, both of No 315 Squadron, were already on their way down — their Spitfire IXs trailing flame and black smoke as they cartwheeled against the patchwork quilt of fields many thousands of feet below. Several Fw 190s continued in their plummeting dive, without giving the Escort and Escort Cover Wings a chance to engage.

For the Biggin Hill Wing, still some 15 miles (24 km) to the south-east of Caen, the chances of an engagement seemed to be dimishing. They could see the pyramids of flak bursts high over the town and airfield, intermingled with the sunbursts off frantically turning Spitfires and Focke-Wulfs. But they were still too far away. Perhaps all the pent-up optimism and expectation in the success of this mission had been misplaced, but then far below the Wing, two Focke-Wulfs appeared climbing hard from out of the haze.

When the order to scramble was received by I/JG 2 at Triqueville, only a few Fw 190s of 2. *Staffel* were able to make a belated take-off, largely because of problems of unserviceability and the fact that the pilots had been placed on 30 minutes readiness instead of maximum alert. However, six or seven Fw 190s of 2. *Staffel* eventually took to the air under the leadership of their 22-year old *Staffelkapitän*, Oblt Horst Hannig, and made height in the direction of Caen while the rest of the *Gruppe* was engaging Circus 297.

(Above) Sqdn Ldr Jack Charles, DFC, in his Spitfire IX. As OC No 611 Squadron, he shot down the German ace Oblt Horst Hannig on 15 May 1943, later rising to the rank of Wing Commander and winning the DSO and a bar to his DFC in the course of achieving 15½ confirmed victories. (Left) The brilliant and enigmatic commander of JG 26, Major Josef Priller.

Horst Hannig had seen most of his combat flying with 6./JG 54 on the Eastern Front. After shooting down 48 Soviet aircraft he had been awarded the *Ritterkreuz* (Knight's Cross) on 9 May 1942, and up to the time of his posting to Northern France, in January 1943, had raised this tally to 90 "kills". Like many successful German pilots who had gained their spurs on the Eastern Front, Hannig found that the quality of enemy fighter opposition in the West was far higher than that experienced in the East. Here in Northern France one had to be careful, but his long experience had enabled him to sustain the pace and he had added another eight Allied aircraft to his already impressive total. But today was to be different. The *Staffel* was strung out over a considerable distance as Hannig, with his wingman, Uffz Ernst Gödde, levelled out at 18,000 ft (5 500 m) and accelerated towards the mêlée over Caen. Intent on catching the retreating Mitchells, the two *"Richthofen"* pilots never saw the pack of Spitfires hovering above in the blinding rays of the afternoon sun.

But the eager eyes of the Biggin Hill Wing saw them, and within seconds the laconic orders of Deere had set the killing match in motion. Yellow Section of No 611, led by Sqn Ldr Charles, was ideally placed to intercept the two Fw 190s and half-rolled into a plummeting dive. At the exact moment that No 611 Squadron went down, Cmdt Mouchotte, flying with No 341 at 25,000 ft (7 600 m), swung into a tight 180-deg turn with the intention of bouncing any of the Focke-Wulfs that might have been split up by No 611's attack. As he completed the turn his anticipation was proved correct for there, 4,000 ft (1 220 m) below him and flying on a westerly course, was a lone Fw 190. It all happened so quickly that no one could tell which pilot — Charles or Mouchotte — shot down the 1,000th.

Charles approached the No 2 of the pair of Fw 190s diving towards Caen, and opened fire from line-astern closing from 250 yards to 50 yards: there were several strikes as the result of his four-second burst — on the wings and along the length of the fuselage. As he swept passed the doomed Focke-Wulf, he opened fire on the leader who swung into a tight right-hand turn, but it availed the German pilot nothing as cannon shells chewed his wing into fragments. Charles broke hard left and as he turned he saw a parachute where the first combat took place. Yellow 3, Flt Lt J M Checketts, confirmed that the first pilot had baled out while the second aircraft dived straight into the ground.

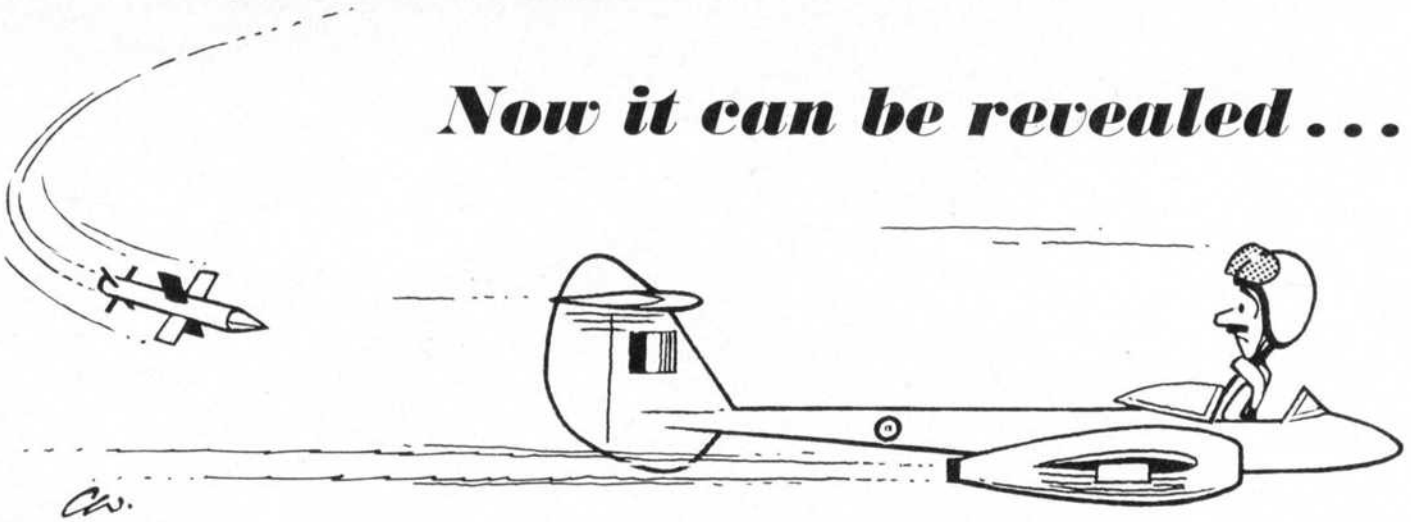
Mouchotte opened fire at 250 yards seeing several strikes on the cockpit and wing roots of his Fw 190. At this point the Focke-Wulf pulled violently into a vertical climb and then exploded in mid-air forcing Mouchotte to pull sharply away to avoid the whirling hail of debris and bits of dural. All three of 2. Staffel's Fw 190s were hurtling earthwards within seconds of the first burst of cannonfire from the two Allied pilots.

Fighter Command's claims on the Caen mission were four destroyed and one damaged Fw 190s for the loss of two Spitfires; of these combat kills, the fourth Fw 190 was claimed by F/O Stanislaw Blok of No 315 Squadron, but the area in which 2./JG 2's casualties occurred confirm the authenticity of claims of Sqn Ldr Charles and Cmdt René Mouchotte. One of these had indeed been the 1,000th victory of the Biggin Hill Wing.

That night the accolades and congratulations began to pour in from every quarter. The honour and the prize money were duly shared by Jack Charles and René Mouchotte, and at a party at the Hyde Park Hotel, which had been fortuitously arranged for that night by the *Alsace* Squadron, the beer and spirits flowed freely. The Wing Commander Flying had pleaded with Group before the party for the Wing to be stood down on the following day and was assured that only in the last resort would the Wing be used on operations.

Predictably, No 11 Group took the last resort, and the following morning, at 1035 hours, the Wing was on its way to Portreath, in Cornwall, whence it operated as top cover to No 2 Group's Venturas on Ramrod 66 to Morlaix. Fighter opposition was minimal and it was a very jaundiced group of pilots who landed back at Biggin Hill that evening. Despite their grousing, the pilots learned that Group had had a heart after all, for they might well have been sent on Circus 298 that afternoon — the targets were Triqueville and Caen-Carpiquet — and a considerable number of JG 2's fighters were in the air although combats were few. If there could be quarter for RAF pilots with sore heads, then, in May 1943, there could be none for the *Luftwaffe*. □

Now it can be revealed...



The Green Meat Saga

...in which Roy M Braybrook recalls the joys of National Service in the Royal Air Force

SOME YEARS AGO I was offered a well-paid job abroad. Among other preparations for the move, I wrote to what was then the Air Ministry, and enquired about disposal of the light blue uniform that I had cared for so lovingly and so long. Anyway, it was cramping the growth of my wine cellar. I confidently expected a tear-stained reply to the effect that, if I really *had* to live abroad, my combat clothing would be carefully preserved for me at Uxbridge alongside one Short Magazine Lee Enfield and 10 rounds of 0·303, against the day that the Communist hordes swept across Europe. Imagine, therefore, my surprise and dismay to receive a terse response to the effect that my name had already been removed from all reserve lists, and that there were no forseeable circumstances under which Her Majesty's Government would be calling on me to bear arms in its name!

The general tone of the document suggested that our past liaison had been an unfortunate mistake, an unpleasant affair best swept under the carpet or flushed down the pan. I forget the precise words, but the Air Staff added something on the lines that, provided I tore from my uniform the badges of rank and medal ribbons (well, the badges of rank), I was perfectly at liberty to screw whatever I could out of the nearest rag-and-bone man for it!

Now the idea of an embittered CAS (Chief of Air Staff) going through the records with sulphuric acid, removing all references to 5028901 Braybrook R (I'm afraid I don't remember my 1250 number, Chief) struck me as little short of unfair. I myself looked back on our two-year association as one of considerable mutual benefit and had rather hoped that he secretly felt the same way. Casting my mind back to those far-off days, I can only imagine that this hate campaign is associated with what we called Project Green Meat, which (I would point out in my defence) actually had quite a serious purpose and was not really intended to make the Royal Air Force the object of derision and scorn. Well, not entirely. To save some future historian the trouble of deciphering those gorgonzola-like files, perhaps I should place my side of the story on record.

Follies of Youth

Before I start, let me emphasise one point. The Royal Air Force is constantly changing, and has been doing so ever since its inception on that aptly-chosen day, one April 1st. The service of which I write was truly a far cry from the RAF of pre-war years, reportedly the best of flying clubs for some, and a refuge from unemployment for others. Nor did I see any sign of the magnificent organisation that later put a thousand heavy bombers over (theoretically) a single target. By the same token, my Air Force was a whole generation away from the smoothly-running, hyper-efficient, computerised operation that is today's RAF. As the song says, it's all so different now, and — if not — it damned well should be!

It may seem ironical (and will perhaps give rise to touching expressions of pity from those who are currently "in"), but throughout my youth I actually *wanted* to join the RAF. Long before I was old enough to enlist, I was down at the local recruiting centre, absorbing all the propaganda in the brochures like some great pimply sponge. I recall one pompous briefing to the effect that *nobody who was anybody* spoke of the gallant service as "The Raff". Many years later I was to discover that this invaluable advice was perfectly true. In fact none of my contemporaries would have dreamed of referring to it as anything but "The Mob"!

In retrospect, it was probably the strain of reading all those leaflets that deprived me of my distant vision, and the RAF of its best potential fighter pilot, or — as the French would say — its biggest *As*.

It is equally ironic, since what ultimately followed were two of the better years of my life, that by the time I had reached the age for national service, I was doing my best to avoid the whole thing. I had managed this very successfully for five years, and was busy planning a retirement villa on the Riviera, when my call-up papers suddenly arrived. These I discussed with the Personnel Manager of "Keystone Aviation", where I was working. There was obviously, he said, some stupid misunderstanding. An over-zealous berk of a clerk had evidently not taken on board the fact that I was doing work of national super-priority. I could rest assured that there was not the slightest chance of my joining the armed forces.

If I had been more worldly-wise, my mind would have been jamming out this conversation with a video overlay of an old gentleman pausing on the steps of his Lockheed 14 (G-AFGN for the 'plane buffs), triumphantly to wave a piece of paper and announce *"Peace in our time"*. Or that equally prophetic comment by Hitler to Goering in 1938: *"Krieg gegen England? No way!"*. A few weeks later I was at Cardington, being issued with an airman's uniform and a postman's hat.

Square-Bashing

Life in the service was different in many ways. For the first time I was having to make a positive effort to steer clear of trouble with authority. On the other hand, as we detrained near our square-bashing camp, I was deeply touched to hear the officer in charge order his minions to keep us under cover until our transport arrived, in case it rained. This attitude contrasted strongly with my experience of industry, where executive responsibility was apparently limited to screwing down the staff's demands for pay increases each Christmas. Here was one chap who evidently had to answer for the well-being of his charges!

It was explained to me many years later that the RAF is actually descended from one of the older (and arguably rougher) regiments of cavalry, in which it naturally paid the officers to ensure that the

poor dumb animals who did all the hard work did not become mangy or contract hard-pad! This "Cavalry Theory" probably has something to do with the old biplanes having stirrups at the ends of the rudder bars and what appear to be reins to the control surfaces.

The hut in which we lived at Padgate was a shining example of clinical cleanliness. We originally had some harsh comments to make on our corporal's insistence that we maintain the gloss on the lino by skidding around on little squares of blanket. Our attitude persisted right up to the evening we visited a friend who had (in a moment of weakness) signed on for an extra year, and thus was a "regular". This particular hut was filthy beyond description (unless you have tried a low-budget holiday in Old Delhi), and we were very quiet about our lino skating after that.

Much of our time was taken up with square-bashing, which I had long feared, having seen the army films of morons screaming unintelligible orders at their squads. For any reader who has never been "in", I might explain that in real life each order starts with a carefully enunciated description of what the DI (drill instructor) intends, followed by a sharp word of command to get the whole circus started at approximately the same time. The transformation in our drill over that six-week period was no minor miracle.

However, whether anyone would have rated us as fighting men is another matter. Even at the end of the course, our squad still included members who were a positive menace with a rifle, even if you were standing directly behind them. I also recall one line-up for injections, when six men fainted just at the sight of the needle! I can't really imagine Uncle Joe staying awake at night worrying about us.

Our lives were supposed to be fairly hectic, but they were by no means unbearable. I enjoyed the comradeship, which they say surfaces whenever men find themselves all dumped together in the same ghastly mess. The RAF undoubtedly had a problem in absorbing the complete spectrum of humanity: not just "the long and the short and the tall", but everyone from shy little boys who had never left home to professional gangsters. The miracle was that the system failed so seldom.

Mixing with people from all walks of life had a positively educational aspect, which somehow never crept into the recruiting posters. In six weeks I learned all about income tax returns, how to pick locks and (from a judo black belt) what to do if kicked in the groin! To date, I have never had to scare anyone to death with an SMLE or a Bren, but the extra-mural instruction proved invaluable.

The diversity of recruits produced some good natural comedians, and a visit to the *Astra* cinema when a really terrible old film was showing was always good value. The other cinema we patronised showed American-made films warning us off certain diseases, with verbal advice from our own medical people to stay healthy and set an example to all those diseased Yanks down the road at Burtonwood! At that time there was still resentment at the way the over-paid Americans had come across when the war was half over, and cornered all the women and booze. We were instructed how to recognise USAF badges of rank, but with the warning: "And if I catch you saluting an American officer, YOU'RE FOR IT!"

All this time I was receiving a generous 28/6d (£1·42½) per week, and my wife was paying £8 for our flat, so she applied for National Assistance, a request that was instantly rejected. A few weeks later the RAF started bombing airfields around Cairo (remember Suez?), the public image of airmen changed overnight from time-wasting layabouts to the "boys in blue", and my wife had to move to a larger flat to find room to stack the assistance money. Later, when my rank suddenly rose by four steps and this promotion was back-dated, I found there was no way they could ask to have the money refunded, which made the whole affair even more satisfying!

"... the transformation in our drill ... was no minor miracle."

"... cold little girls ... instantly transformed themselves into little ravers."

Just prior to our passing-out parade, we went through the career selection process, where the general concern was not to be stigmatised with the letters SP (Service Police). We had made a lot of friends, and had no wish to lose them!

Some better-informed members didn't mind what trade they were given, as long as they were posted to Squires Gate. It used to be one of the stranger British sociological phenomena, that all the cold little girls who had been giving their home-town boyfriends the Venus de Milo (hands-off) treatment all winter, would pair up for summer hols in Blackpool, where they instantly transformed themselves into little ravers! By September, a pay parade at nearby Squires Gate looked like roll-call in a Nazi death camp. Bloodshot eyes, blinking in the unaccustomed sunlight, peered nervously from darkened hollows in twitching, ashen faces. Life expectancy was short, but nobody was ever successfully posted away from Squires Gate without the use of explosives!

I applied to be a Russian interpreter, which promised stints with emigré colonies in Vienna and Paris, before crawling around the Iron Curtain listening to Soviet Air Force radio transmissions. My disappointment at being sent instead to help the Misery of Supply with guided weapon trials was alleviated some years later, when I overheard a conversation between two Americans in a bar in Beirut. One had been flying around listening to the radio chat between two Soviet girls controlling fighters in adjacent sectors. What vital intelligence did they unwittingly disclose? One said "How are you, Natasha?", and the other said, "I was dancing all night with our big ox of a station commander, and my feet are killing me!"

Weapon Trials

The unit I served with was formed to overcome a shortage of civil servants in the early days of guided weapon testing. In reality, we were finding out how future trials should *not* be run, in the hope that later missiles would actually work. The section heads were civilians, and we saw an officer once a pay-day, or when the "real" Air Force on the other side of the airfield gave us flights in their old Lincoln bombers. We were allocated the trade of Scientist, and anyone with a university degree became a Senior Tech (which meant three inverted vees, lad!).

We lived in a civil service hostel, with a sports club just across the main road where you could tank up on cheap booze. The trick was to cross the road back to safety while you could still see the traffic, prior to finishing off the evening in a convenient pub, whence you could crawl to bed on all fours, if necessary.

Once our bosses had got used to airmen screaming down the department corridors *"One year, three months, five days!"* (for example), they tolerated us quite well. We discovered that civil servants were either absolutely brilliant or absolutely lazy, but fortunately the girls were neither. At the hostel we were told that airmen must not set foot inside female accommodation, a badly-worded order that proved an irresistible challenge for one athletic colleague. His wife believes he got the limp in a skiing accident!

In the same way that the Air Force was kinky about sports and music (it was reckoned in my day that an AC2 who boxed *and* played the trombone could safely address the CAS as "Old Cock"), the civil service was bananas about education. Anyone who wanted an afternoon in London each week could simply put his name down to research the more bizarre aspects of Polynesian mating customs, and he was away!

Added to this was the satisfaction of knowing we were far wealthier than old school chums who had commissions and mess bills. Only two things worried us. The first was the threat that anyone caught doing something totally outrageous would be posted to Woomera, which was said to be notable for heat, flies, and the absence of girls. The other fear was of contracting any serious illness, since (although our RAF MO across the field was highly regarded) hospitalisation meant trusting our precious lives to the Army, which

Jaguar, now in Squadron service

Can you join the RAF without a degree?

...or, come to that, without O-levels?

The answer is Yes. There are many different methods of entry. The principle is this:

To join as an officer, the minimum educational requirement is 5 acceptable GCE O-level passes at Grade C or above, preferably with one or more at A-level, and subjects must include English Language and maths; or equivalent. Some branches – notably Engineering – require a degree or professional qualification. Others do not – and these include flying, air traffic control and administration.

Generally speaking, a degree or above-the-minimum qualifications will always improve your chances. Minimum age for applications is 17.

To join as an airman you need to have, or show you can learn, a skill the RAF can use. ONC, HNC etc., may or may not have a bearing on this according to the trade you are interested in, and the vacancies available when you apply. You can apply from age 16½.

To join as a Technician Apprentice, for a full-time, 3-year trade training course leading to ONC, you need, as a minimum, 4 acceptable O-levels at Grade C or above, including maths and physics (or a science subject including physics); or equivalent. Minimum age for application is 16.

Whichever way you join, one thing is certain. More than anything else, it is *your potential* that the RAF is interested in. They want you to give the very best that you are capable of; and the fact is that a lot of people just don't know what their capabilities are until the RAF discovers and develops them.

More details? Certainly. Look in the telephone book under RAF Careers Information Office, and find the address that is most convenient for you. Ring up, write, or go straight round. No obligation!

Formal application must be made in the UK.

ROYAL AIR FORCE

was not seen as a reasonable gamble. When Asian flu struck, the department looked more like a mortuary than a research office!

Each time the film records came back from the firing ranges, we assembled in the department's cinema, generally to howl with laughter as another expensive missile blasted away from the fighter in a great cloud of black smoke, only to reappear toppling earthwards as the guidance failed. The theory was that the weapon would ride down a radar beam directed by the fighter at the target, but we were all convinced that one day the smoke would clear to reveal the missile riding *back* down the beam to the fighter!

However, time passed, and we began to be involved with later missiles which really did work. It was fairly true to say that with the first generation we could hit nothing, with the second we could reliably hit the target aircraft from directly astern, and the third would (it was said) hit from any firing angle. Suddenly the farce was over: we were actually testing weapons that some poor goof might have to use in anger!

This sudden change brought out our sense of responsibility, which up to that point had been stowed away in the hold, labelled *"Not Wanted on Voyage"*. Immediately, we were in conflict with the civil servants over security, since they evidently believed that simply giving a missile a code-name (Red Dean, Orange William, Blue Steel, etc) created an inpenetrable barrier against enemy intelligence. The department walls were thus covered with pegboard displays of trial results, which everyone from the bog-wallah down to our visiting accounts officer could understand.

Green Meat

As a stop-gap measure we substituted our own code-names for their code-names. Blue Sky became Vermilion Shagnast, and Blue Jay became Purple People-Eater. The natural extension to this was to invent a missile (which was named Green Meat), and a succession of imaginary firing trials, which were displayed on a spare pegboard. This drew no comment from the civil servants, who had been very properly brainwashed with the "need-to-know" and were not about to be tagged as Communists for enquiring about a project which did not concern them.

However, one day the man from the Purple People-Eater company visited us to discuss progress, and saw to his horror that Green Meat was progressing quicker and functioning even more consistently than his series. When he commented that his own missile's miss distances averaged out slightly better, we coldly replied that with Green Meat you measured in *inches*, not *feet*! Turning white, he insisted on taking us out to lunch, where (suitably stoned) we revealed to him in strictest confidence that Green Meat was frankly *not* a British missile.

Whereas most of our costly projects had fizzled out like so many damp squibs, Green Meat went from strength to strength. We may never know what finally killed it off. Perhaps the Purple People-Eater people protested at the threat from US technology. Maybe the Secretary of State for Air did not relish the prospect of standing up in the House to answer questions on something called Green Meat. All we know for sure is that one day in Whitehall the Chief ordered the Green Meat trials unit to be given the Hiroshima treatment.

We were all coming up to demob, and he could very easily have let things go at that. Instead, he based his actions on that detective story in which the hero takes the police back to the house where he claims he witnessed a murder, only to find that the bad guys have not just removed the corpse, but changed the furniture around and redecorated the walls as well! Try to check the truth of my story today, and you will discover there is no such trials unit, no such trade as Scientist, and no such rank as Senior Tech. Nobody is kitted out at Cardington, and nobody bashes the square at Padgate. Indeed, the cover-up was taken so far that the RAF now denies using both the SMLE rifle and the Bren gun! Rumour had it that the Chief wanted to go the whole hog, rename the service the British Aviation Corps and change the uniform to field grey. However, DCAS advised him that both the initials and the colour were already spoken for, so that final embellishment was dropped.

On the day of our demob, the Group Captain came over from the "real" Air Force to make sure that we actually left. "IN NORMAL CIRCUMSTANCES" (he ended through tightly-clenched teeth) "WE INVITE NATIONAL SERVICEMEN TO SIGN ON". Lost (for once) for an equally witty reply, we came to attention, gave him our very best salutes, and started running.

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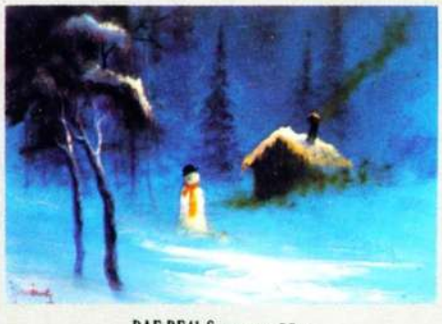

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