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SPITFIRE AND HURRICANE TRIBUTE

Royal Air Force Battle of Britain Memorial Flight





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Edited by: Wg Cdr John Ward AFC, RAF,
and the BBMF crew of 1986



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Foreword

by
Air Chief Marshal
Sir Alasdair Steedman GCB, CBE, DFC, FRAeS, CBIM

Air Chief Marshal Sir Alasdair Steedman was an 18-year old schoolboy when the Battle of Britain was fought. However, at the age of 20 he was a fighter pilot, initially flying Mustangs in Scotland, and then Hurricanes and Spitfires in the North African and Italian campaigns from 1942 to 1944. He well remembers the versatile Hurricane — he flew both the Mk IIb and the IIc 'Hurri-bombers' — and its thoroughbred companion the Spitfire. It was whilst flying a Spitfire Mk VIII on operations in Italy in June 1944 that he was shot down behind enemy lines. He evaded capture and the following year he was again flying Spitfires, this time on tactical and photographic reconnaissance operations in Europe. In all he was flown at least nine different Marks of Spitfire. His remarkable career, which has taken him all over the world, culminated in his appointment as the United Kingdom's Military Representative in NATO in 1977. Following retirement from active service he became Controller of the Royal Air Force Benevolent Fund in July 1981.

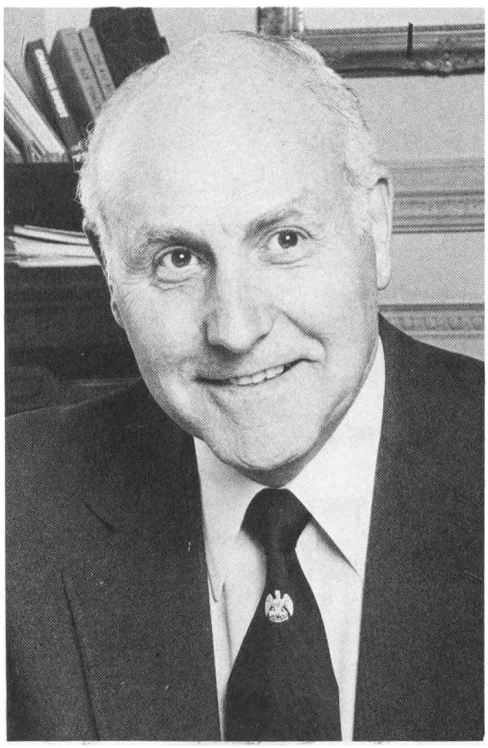
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There are several reasons why the Battle of Britain Memorial Flight has a special place in my affections. It was watching the Battle of Britain over London in 1940 that inspired me to want to fly and to join the Air Force later that year. I then had the immense privilege and pleasure of operating both Hurricane and Spitfire aircraft — many Marks of Spitfire — in operations during the war. Now the Battle of Britain Memorial Flight is the source of many donations to the Royal Air Force Benevolent Fund, of which I have the privilege to be the Controller, and 50% of the proceeds from this book will come to the Fund.

It is marvellous that those wonderful aircraft which played such a major part in gaining victory in the Second World War should still be flying under the dedicated care of the personnel of the Battle of Britain Memorial Flight.

I warmly commend this excellent book to all interested in aviation and a key part of our history.





Above:
Air Chief Marshal Sir Alasdair Steedman GCB, CBE, DFC, Controller of the Royal Air Force Benevolent Fund.

Acknowledgements
The Battle of Britain Memorial Flight gratefully acknowledges the help and co-operation of the following, without whom this book would not have been possible: Campbell Gunston, Flight Historian; The Spitfire Society; British Aerospace Kingston, Preston, Salmesbury, Weybridge; Rolls-Royce; Air Historical Branch; Public Records Office; Donna.

Cover:
Hurricane PZ865 with Spitfire P7350.
Richard Winslade

Rear cover:
Seven Spitfires were assembled for the IAT 1983. AB910 is seen here.
Allan Burney

The Battle of Britain

Through the ages the people of the islands which we know today as the United Kingdom have seen a long succession of conflicts. Many were fought in far-away lands, others on the green fields of our Nation's heartland. As with so many battles before, World War 2 began, for the British people, as the result of a stand against tyranny and oppression, and the country quickly found itself in a race to build up its military forces, having started in a position of massive disadvantage. The people faced an enemy able to strike almost at will at their towns and cities; able, for the first time in almost 900 years, to carry the war to their homes. (The Zeppelin and Gotha bomber raids of World War 1 caused great alarm at the time, but were effectively only nuisance raids.) But the Battle of Britain was also fought in the full view of the people: through those hot sunny days of 1940, high in the skies of South-East England, they could watch each thrust and parry of the battle that would decide their destiny.

The rapid fall of France and the evacuation from Dunkirk in June 1940 left these islands vulnerable to the German air armadas. That same month Goering gave his Luftwaffe, flushed by a long and impressive succession of victories across Europe, the instructions to 'attack the Royal Air Force, by day and night, in the air and on the ground'. Britain stood alone, against the greatest war machine the world had ever seen.

'What General Weygand called the Battle of France is over. I expect that the Battle of Britain is about to begin. Upon this battle depends the survival of Christian civilisation. Upon it depends our own British life and the long continuity of our institutions and our Empire. The whole fury and might of the enemy must very soon be turned on us. Hitler knows that he will have to break us in this island or lose the war.'

Winston Churchill, House of Commons
19 June 1940.

Although it was not apparent at the time, 10 July 1940 is now officially accepted as the day on which the Battle of Britain began. Goering's aircraft lost



Above right:
Pilots of No 41 Squadron during the Battle, recording their victories on a broken propeller blade. On the left, supporting the blade, is the CO, Sqn Ldr Finlay, whose aircraft was commemorated on the Memorial Flight's Spitfire P7350. *Crown Copyright*

Below:
Vapour trails left during a dog-fight over Maidstone during the Battle of Britain. *Kent Messenger*





Above:
The pilots of No 41 Squadron at Hornchurch during the Battle. *Crown Copyright*

Below:
Standing silent vigil on either side of the entrance to St George's Chapel of Remembrance at Biggin Hill are Spitfire XVI SL674 and Hurricane IIC LF738. Neither aircraft saw operational service during World War 2.

This Hurricane is currently with the Medway Preservation Group of the Royal Aeronautical Society, which is actively seeking financial assistance to restore it to flying condition for the Battle of Britain Memorial Flight.

no time in taking over the vacated airfields of Northern France and began to implement his orders. Initially the Luftwaffe attacks were predominantly against Channel shipping and coastal targets, although the bombers were also probing deep into England's industrial heart. Despite the total number of fighters on Royal Air Force strength at that time being some 200 fewer than the fighters of Luftflotten 2 and 3, which were deployed in France and the Low Countries, Fighter Command's initial objective had to be to stop the bombers and avoid unacceptable losses in the process. The combined bomber resources of Luftflotten 2, 3 and 5 — the latter operating from Scandinavia — numbered well over 1,500 aircraft, and their spread denied Fighter Command the ability to concentrate its fighters in the South. With the need to ensure that a number of fighters were always ready on the ground to meet follow-up raids, Air Chief Marshal Sir Hugh Dowding, Commander-in-Chief of Fighter Command, could not afford to commit his fighters in strength against the massed German air attacks ranging across the Channel — he simply did not have enough available.

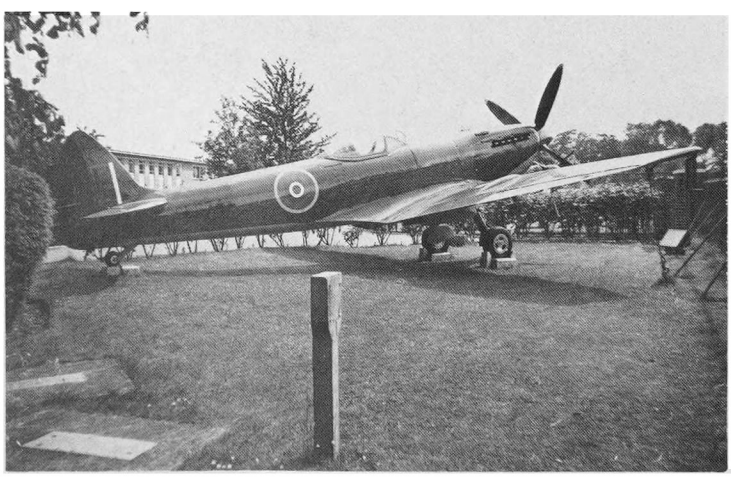
Having failed to lure British fighters into combat in any significant numbers, where it had hoped to destroy them with overwhelming odds, the Luftwaffe prepared confidently for the invasion by turning its attention, in early August, to the chain of coastal radar stations which provided Dowding with the initial warning of the enemy's approach. But the full importance of the radar stations, and the system whereby Dowding's fighters were controlled by Sectors, was not fully appreciated by Goering's planners; in mid-August Goering directed that his forces should concentrate on the fighter airfields instead.

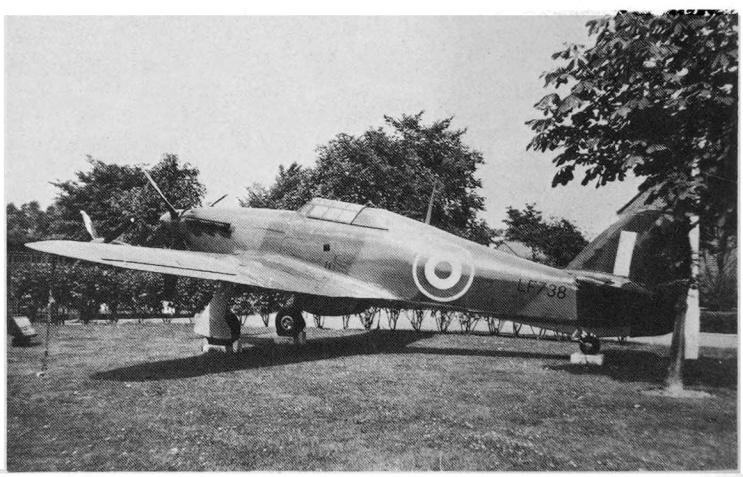
'Let us therefore brace ourselves to our duties, and so bear ourselves that, if the British Empire and its Commonwealth lasts for a thousand years, men will still say "this was their finest hour".'

Winston Churchill, House of Commons
19 June 1940.

At this stage of the Battle, Dowding's major concern was not so much his acute shortage of fighters as it was pilots to fly them. Astute planning and preparations, despite a great deal of political foot-dragging, had ensured that, by August 1940, the factories and repair organisations were just about able to keep pace with the losses, turning out almost 500 new Hurricanes and Spitfires in July alone. Fighter pilots could not be replaced so easily. Squadrons were 'rested' by moving them, in turn, to airfields in the North for short periods, away from the fighter threat. Whilst there they still played a full part in defending the country against attacking bombers, but the respite gave an opportunity to coach the new arrivals fresh from training schools.

Of the four Groups that constituted Fighter Command, No 11 Group bore the brunt of the Luftwaffe attacks. Commanded by Air Vice Marshal Keith Park, No 11 Group was responsible for the air defence of the South-East — from Southampton to Great Yarmouth, including London and the Home Counties. Park had, in August 1940, some 13 Hurricane and six Spitfire squadrons,





operating from 15 airfields. His dilemma, as the Luftwaffe launched its onslaught against his airfields, was to decide how many of his precious fighters to commit the battle, knowing that he must always have reserves to meet follow-up raids. Nonetheless, to leave aircraft on the ground was to risk their destruction in any successful air attack. In practice he had little choice but to scramble his fighters as soon as the enemy raids were detected, hoping that by meeting them before they got too close the attack would be disrupted and also allow his fighters more time to tackle the bombers.

It was vital, with the limited number of fighters available, that the defenders ignored the Bf109 and Bf110 escorts and concentrated on the bombers. When circumstances allowed, the Spitfires, with their better manoeuvrability at high altitude were directed to take on the escorting fighters, leaving the Hurricanes to deal with the bombers. In the face of repeated attacks Park could call for assistance from No 12 Group, which covered the area from Cambridgeshire northwards to mid-Yorkshire. No 12 Group was commanded by Air Vice Marshal Trafford Leigh-Mallory, who felt that Park's tactic of scrambling his fighters in sections or squadrons was wrong and he made no secret of his disagreement.

There is no doubt that Goering's massed formations of bombers and fighters made daunting opponents. His pilots were operationally more experienced, having had the opportunity to prove and develop their skills and tactics in the Spanish Civil War and across Europe. Leigh-Mallory's answer to these attacks was to counter with massed formations of Hurricanes and Spitfires — four or more squadrons — in what was known as the 'big wing' concept. He was supported in this idea by some of his squadron commanders, men such as Sqn Ldr Douglas Bader who commanded No 242 Squadron at Duxford at the time. But the 'big wing' took a long time to assemble — once an enemy raid had been detected there was often insufficient time; it had to be engaged without delay before it reached its target. There was also the major disadvantage that the 'big wing' could only be in one place at a time. If so many fighters were committed to one raid — which may have been a diversion — there would be nothing in reserve to counter other attacks directed at knocking out the airfields.

The losses and damage being inflicted on Dowding's men, aircraft and airfields during August and into the first week of September were extremely heavy. Groundcrews worked day and night to repair and re-arm the aircraft, constantly harassed by air attacks, while for the Hurricane and Spitfire pilots, often desperately tired, the days blurred into an endless succession of peaks and troughs. The days started long before dawn — either for standby or, for some, the dawn patrol looking for the first attacks of the day. A high spot would be to recover safe and undamaged at base with an enemy aircraft 'in the bag'; to watch a friend plummeting earthwards or to wait in vain for those that never returned brought a numbing sadness.





Above:
Two medals awarded to Air Vice Marshal F. D. S. Scott-Malden who was a Pilot Officer with Nos 611 and 603 Squadrons during the Battle of Britain.

A 1939-45 Star with Battle of Britain Bar.
A Distinguished Flying Cross and Bar, awarded in 1941 and 1942 respectively.

Although Fighter Command's losses were heavy, those inflicted on the enemy were even heavier. Despite the confidence and reassurance of their generals, the attacking bomber crews still found themselves being mauled severely by the Hurricanes and Spitfires. Already Hitler was beginning to accept that the invasion of Britain would not take place that year.

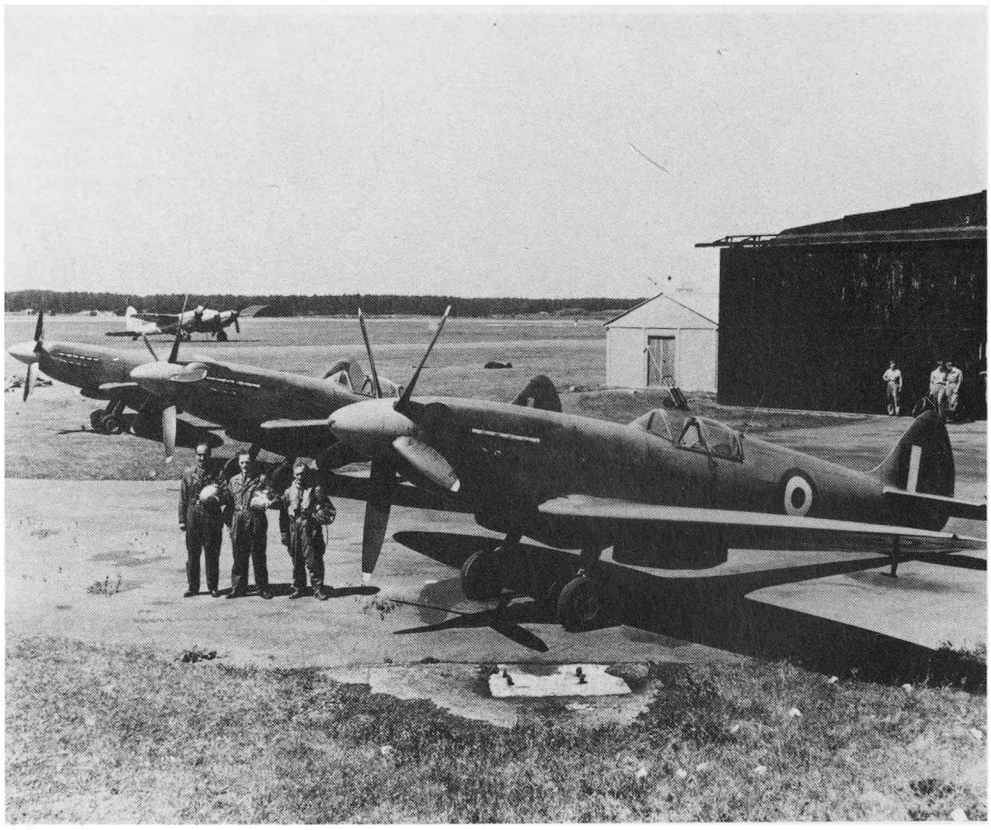
Goering's frustration at the inability of his much-vaunted Luftwaffe to destroy the Royal Air Force led, at the end of that first week of September, to his fatal decision to switch his attacks to the cities — and so gave Dowding's airfields the respite they needed. His action was no doubt influenced by Bomber Command's air attacks on Berlin but it gave Fighter Command the chance to rebuild its forces and, in due course, to establish control of the Channel skies. Although some daylight attacks continued, by the end of October 1940 most of the surviving bombers had been switched to night operations against the towns and the nation's industrial targets. Even so, large formations continued to attack almost daily throughout October — over 1,000 sorties were flown by Fighter Command on 27 October alone — but with his airfields free from air attack, Dowding's Hurricanes and Spitfires were able to respond in strength and Luftwaffe losses that month were almost twice those of the Royal Air Force.

There can be no doubt that without the Hurricane and Spitfire, the foresighted men who had designed them and the pilots that flew them, the Luftwaffe would have been able to continue its successful sweep into England in support of the invasion. As they had demonstrated so clearly in Europe, by destroying the Royal Air Force Goering's bombers could then have laid open Britain's ground defences and, following Operation 'Sealion', left Britain at the mercy of the Wehrmacht.

'The gratitude of every home in our Island, in our Empire, and indeed throughout the world, except in the abodes of the guilty, goes out to the British airmen who, undaunted by odds, unwearied in their constant challenge and mortal danger, are turning the tide of world war by their prowess and by their devotion. Never in the field of human conflict was so much owed by so many to so few.'

Winston Churchill, House of Commons
20 August 1940.

A Living Memorial



Above:
Mk XIX Spitfires of the Met Flight at Woodvale on 12 June 1957. The pilots are (left to right) Eric Richards, John Formby and Alan Grummet. In the event, problems with all three aircraft prevented their departure for Duxford that day. In the background is one of the Mosquitos which took over the Meteorological task.

Below:
The Flight is born. The three Mk XIXs join Hurricane LF363 at Biggin Hill on 11 July 1957. In the background are the Hunters and Javelins which escorted the Spitfires from Duxford.



The Story of the Memorial Flight

On 15 September 1945 a proud and thankful London turned its eyes upwards to watch hundreds of Royal Air Force fighters taking part in the first of what was to become the annual Battle of Britain flypast over the city. The Royal Air Force too was proud to commemorate its finest hour and the part it had played in preserving the freedom of our nation.

Thereafter, it was most fitting that the flypast should have been led on each occasion by a Hurricane and a Spitfire and, although the format changed each year, this became the established practice. But, with the ending of the war, Hurricanes were rapidly phased out of service and, by the mid-1950s, only one aircraft remained in an airworthy condition in RAF hands — at Biggin Hill. Even so, it was the imminent demise of the Spitfire from RAF service in 1957 (albeit the civilian-operated Meteorological Flight) that eventually brought to fruition the widely-held belief and determination within the Service that the sacrifices made whilst gaining its greatest battle honour should continue to be commemorated in the most fitting way possible.

In June 1957 the Meteorological Flight at Woodvale, operated by a division of Short Bros & Harland Ltd, made its last temperature and humidity-monitoring flight. The Flight's three Mk XIX Spitfires were flown to Duxford by their civilian pilots, two on 14 June and the third on 26 June, where they were handed back into RAF hands. On 11 July 1957, escorted by three Hunters and three Javelins, the three Mk XIX Spitfires flew from Duxford to Biggin Hill, where they joined the lone Hurricane — the Battle of Britain Flight was born, although in the beginning it was more widely known as the Historic Aircraft Flight. The pilots for the flight to Biggin Hill were Gp Capt J. E. 'Johnny' Johnson (a Battle of Britain Spitfire pilot), Gp Capt James Rankin and Wg Cdr Peter Thompson (a Battle of Britain Hurricane pilot).

So, in the beginning, the Memorial Flight consisted of three Spitfires and one Hurricane. Two months later, one of the Spitfires (PS915) was moved to West Malling to be used for ground display purposes. (It spent the next 17 years as a 'gate guardian' before being rescued in 1984 and lovingly restored by British Aerospace at Salmesbury, and will rejoin the Memorial

Flight during 1986.) Later in 1957 two Mk XVI Spitfires which had been used as exhibits in the Royal Tournament that year were, on the instigation of the Station Commander at Biggin Hill, recovered to flying condition by his tradesmen. Because there were difficulties in certain quarters about the existence of the Flight, all of the aircraft were officially held on the strength of the Station Flight. Early in 1958 the Royal Air Force decided to close Biggin Hill for flying operations and so, on 28 February, the two Mk XVIs and one Mk XIX flew to North Weald, at that time the home of No 111 'Treble One' Squadron — the 'Black Arrows'. They were joined there on 3 March by the other Mk XIX and the Hurricane, which had both been delayed at Biggin Hill by a sudden fall of snow.

The stay at North Weald was short lived. In the spring of 1958 the Air Ministry decided that North Weald too would close and on 16 May the Battle of Britain Flight moved again — this time to Martlesham Heath. Sadly, whilst at North Weald, the Flight had parted with a second Mk XIX (PS853) the aircraft being allocated in the April to West Raynham for gate guardian duties, although fortunately it was kept in flying condition and used by the Central Fighter Establishment at West Raynham and Binbrook. It eventually rejoined the Flight in April 1964.

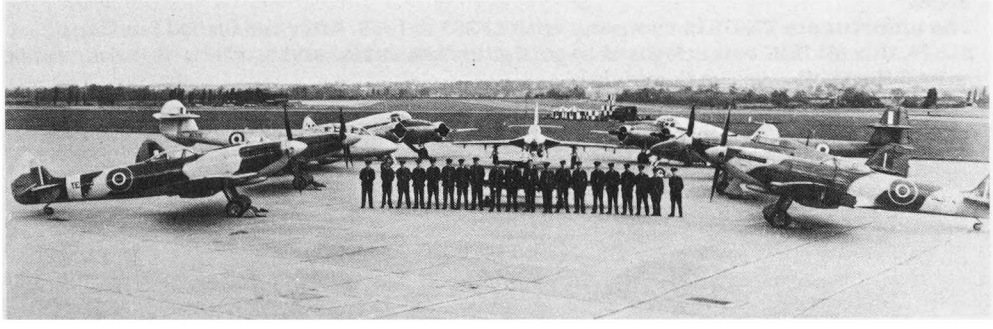
It was from Martlesham Heath that a Mk XVI, in company with the sole Hurricane, led the flypast over London on 20 September 1959. Unfortunately the Spitfire suffered an engine failure which resulted in a forced landing on the Oxo cricket pitch at Bromley in Kent. This aircraft (SL574) never flew again and since November 1961 has stood on display at Headquarters Fighter Command (now HQ 11 Group) at Bentley Priory. Following this accident



Above:
Seen at North Weald in March 1958 are (from left to right) two Mk XVIs, Hurricane LF363 and two Mk XIXs. *R. Mateer via CPG*

Below:
The Station Flight at North Weald in May 1958. On the left are TE476 and PM631, on the right LF363 and SL574. *R. Mateer via CPG*

Bottom:
SL574 and LF363 at Martlesham Heath being prepared for the fateful London flypast on 20 September 1959. *CPG*





it was decided to ban the Spitfire and Hurricane from future flypasts over Central London. Another unfortunate outcome of the forced landing was the completely unsubstantiated conclusion that the Packard Merlin of the Mk XVI was unreliable; as a result the other Mk XVI (TE476) was grounded and disposed of on 5 January 1960. It now sits at the main entrance to RAF Northolt.



Above:
SL574 returns to Martlesham after being recovered from the Bromley cricket pitch. *Crown Copyright*

Below:
The unfortunate TE476 in company with LF363 in 1959. After the forced landing of SL574, this Mk XVI was relegated to gate guardian duties and now sits at the entrance to RAF Northolt. *Crown Copyright*



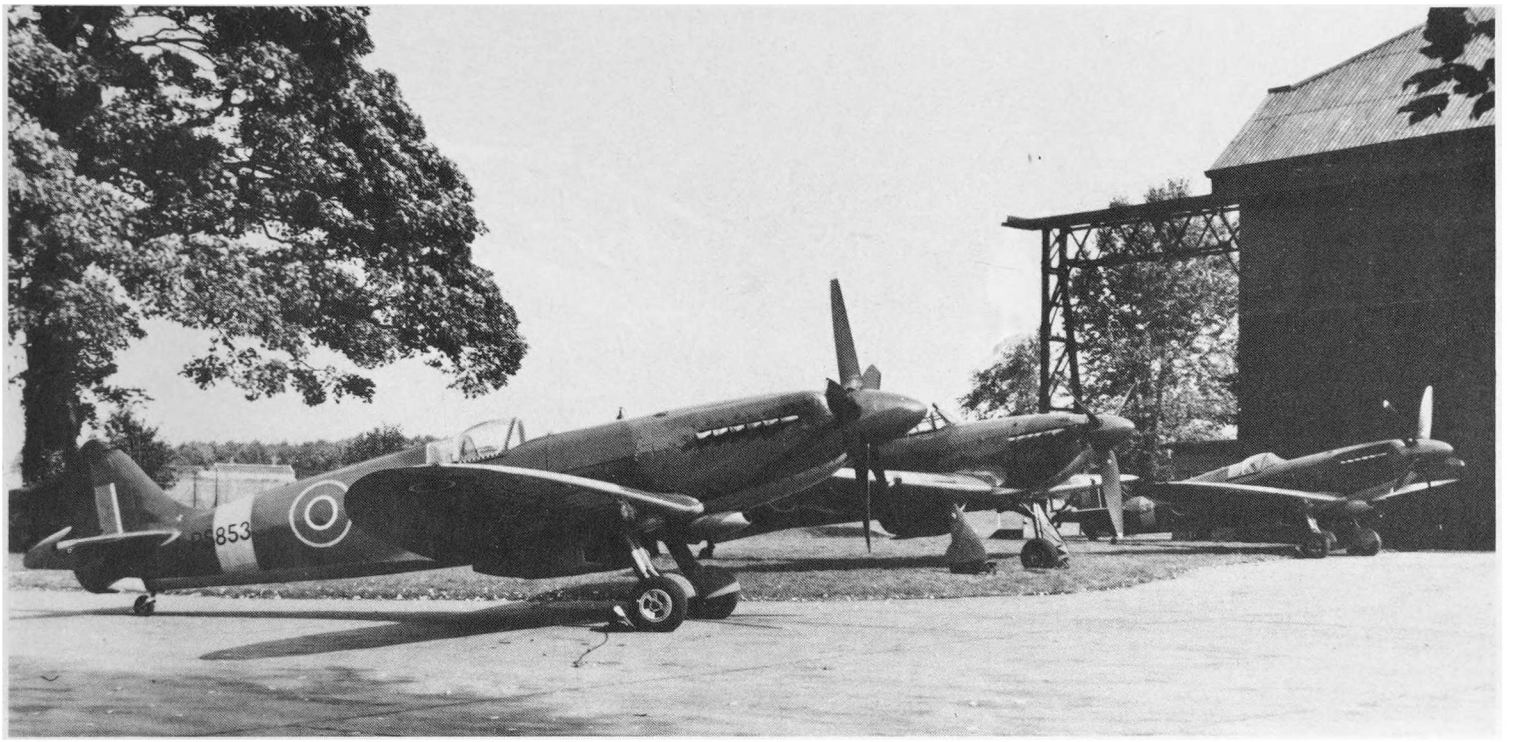
The following year, on 3 November 1961, the Flight moved yet again, this time to Horsham St Faith near Norwich. Following the loss of the Mk XVIs the flight was struggling to survive, having just one Mk XIX Spitfire and the faithful Hurricane. However, there then came a general realisation of the true significance of the Memorial Flight and a number of steps were taken to improve the situation. With the closure of Horsham St Faith the two aircraft were moved to Coltishall on 1 April 1963. At that time Coltishall was Fighter Command's top fighter base, and the next few years saw a gradual improvement in the position of the Flight.

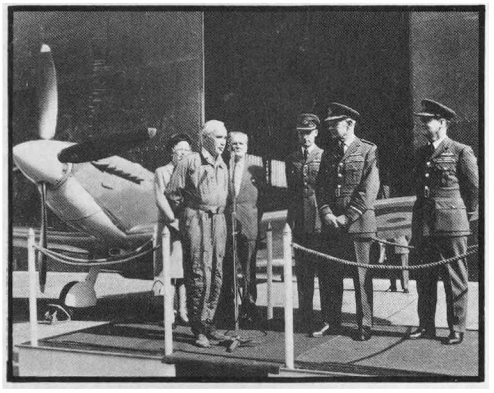
On 16 April 1964 the Mk XIX that had left the Flight at North Weald in 1958 returned to rejoin its stable-mates. During that 1964 display season those three aircraft appeared at a total of 50 displays around the country: by comparison, 20 years later in 1984 the Flight gave over 140 displays.

The following year saw the welcome arrival of a third Spitfire. Having been owned by Vickers Armstrongs Ltd for many years, this Mk Vb was flown to Coltishall on 16 September 1965 by Jeffrey Quill, the company test pilot who had done so much of the Spitfire development flying. The making of the film *The Battle of Britain* in 1968 was also a considerable boost for the Flight; all of its aircraft were used at the various film locations and appeared in a variety of squadron codes. The extensive search for well-preserved aircraft that preceded the filming revealed a Mk II Spitfire in the museum at RAF Colerne. It was in such good condition that it was made airworthy for the film and afterwards, in November 1968, it too joined the Battle of Britain Flight, bringing the Spitfire strength to four. In fact this is the only one of the Flight's aircraft that actually saw combat in the Battle of Britain.

Although the future of the Spitfires was now much healthier, the situation with the faithful Hurricane was less certain. The Hawker Aircraft Co came to the rescue — it had retained the last Hurricane to be built, at Langley in 1944, and used it in support of company projects until retiring it to the Hawker Museum in the late 1960s. Recognising the plight of the Flight, the company completely refurbished *The Last of the Many* and presented it to the Flight at Coltishall in March 1972.

Of course, although this book is concerned with the Spitfire and Hurricane, no story of the Flight would be complete without mention of its other aircraft. Lancaster PA474 is currently the only airworthy Lancaster in the





Above:
When PS853 joined the Flight in 1964, it brought the total number of aircraft on the Flight to three — two Mk XIXs and one Hurricane.

Left:
The presentation of AB910 at Coltishall on 16 September 1965. From left to right are: Air Chief Commandant Dame Katherine Trefusis-Forbes, Vice President of RAF Association, Jeffrey Quill; Air Marshal Sir Geoffrey Tuttle (British Aircraft Corporation, Weybridge); Gp Capt Roger Topp, Station Commander of Coltishall; Air Marshal Sir Douglas Morris, Cdre-in-Chief Fighter Command; and Air Commodore Al Deere, AOC No 12 (East Anglian) Sector.

Below:
Now we are six . . . The Memorial Flight at Coltishall on 25 October 1973.
Crown Copyright



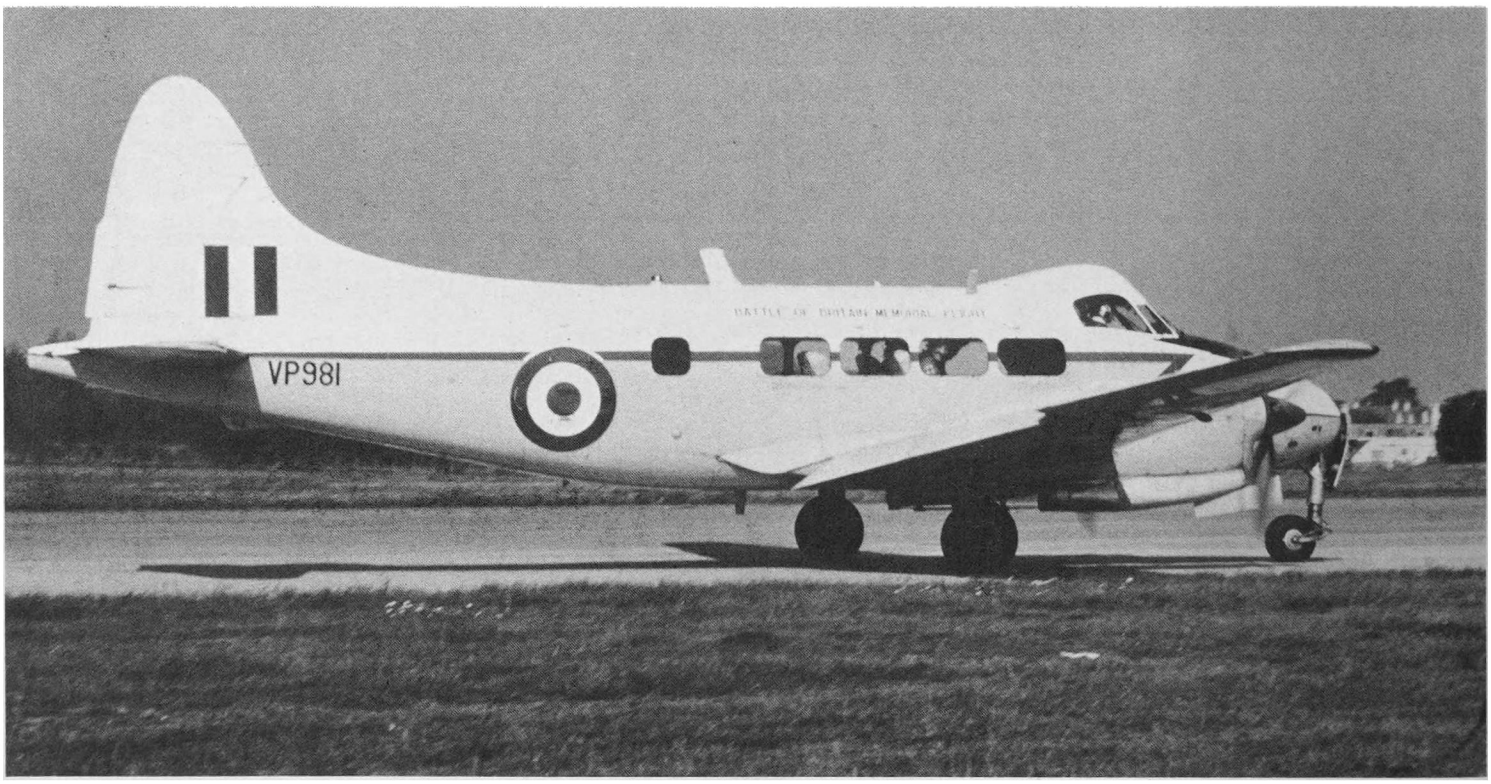


Above:
The Memorial Flight Lancaster and Chipmunk at Duxford on 15 September 1985.
Richard Winslade

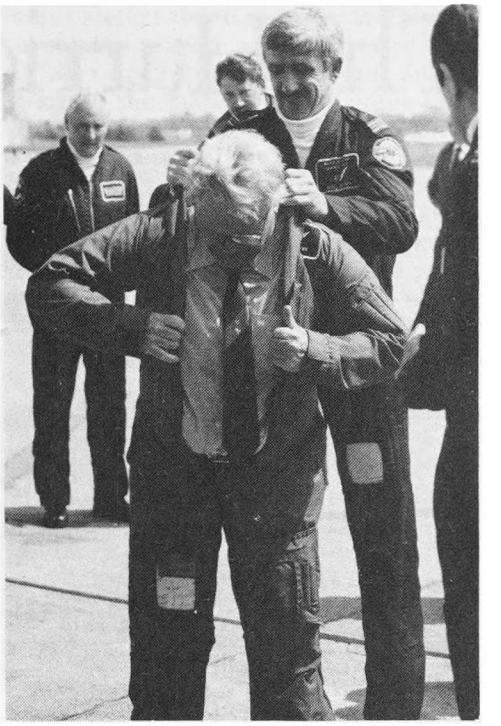
Below:
Photographed at Jersey in September 1985, the Flight's Devon (VP981) provides invaluable support.

world, having joined the Flight at Coltishall in 1973. It too serves as a living memorial to the thousands of airmen who gave their lives in the service of their country, and is usually seen during the season with its escort of a Spitfire and Hurricane. With the arrival of the Lancaster the name of the Flight was amended to 'Battle of Britain Memorial Flight'. The Flight also has a Chipmunk which is used to provide the pilots with essential continuation training in piston-engine and tailwheel handling techniques. Completing the scene is the work-horse of the Flight — the Devon, which arrived in May 1985 following the disbandment of No 207 Squadron at Northolt, where Devons had operated for many years. The Devon provides essential asymmetric and procedural continuation training for the Lancaster pilots and navigators and is an extremely efficient means of supporting long distance displays, especially those involving several intermediate refuelling stops.

Finally, there are good indications that the Memorial Flight will be able to represent the finest traditions of the Royal Air Force for many years to come. The Mk XIX that was disposed of so readily in 1957 should rejoin the Flight in time for the 1986 season, having been extensively re-engineered to assure a safe flying life well into the next





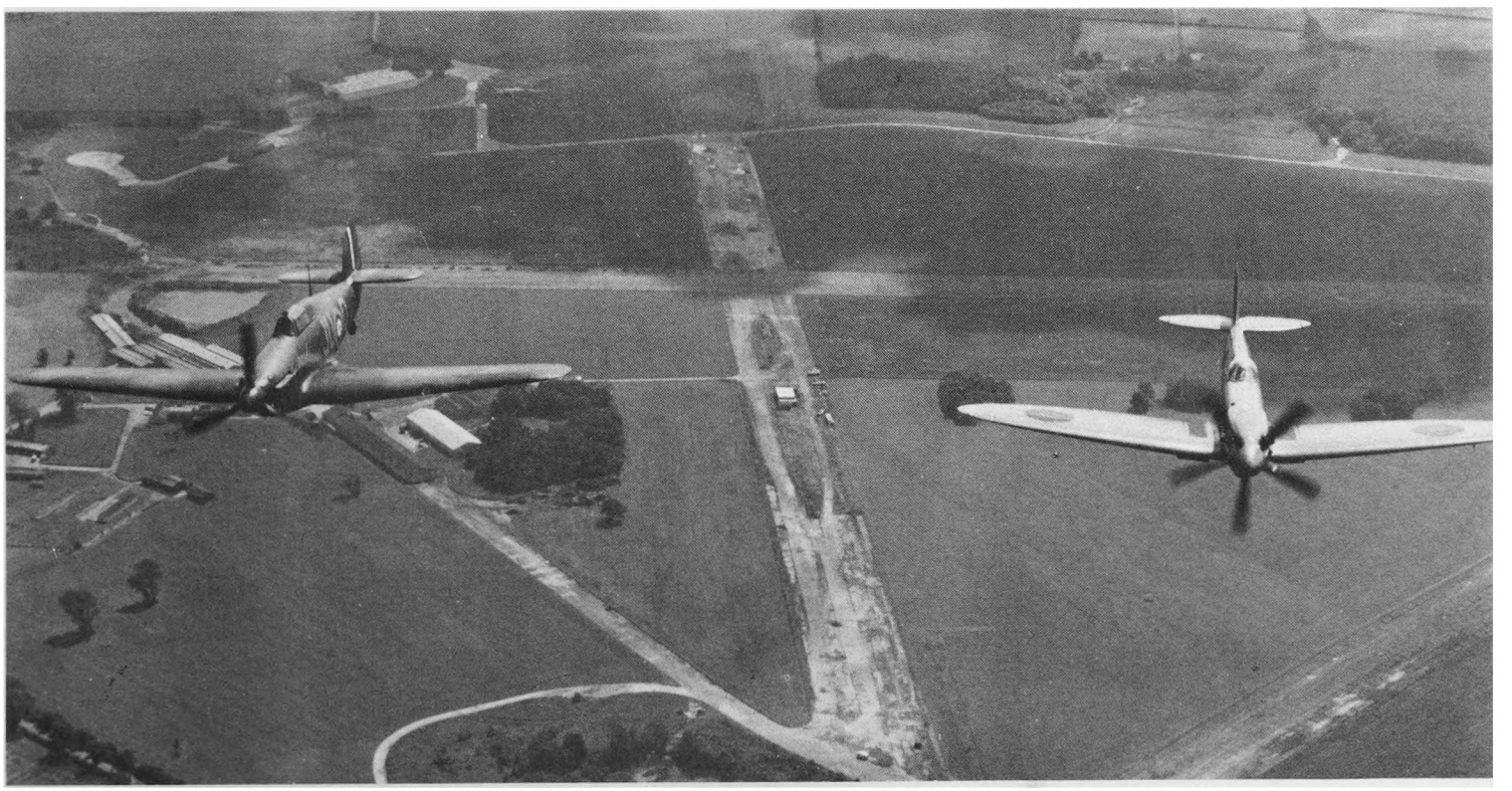


century. An enormous debt of gratitude is due to British Aerospace for that work. There is also hope that the means will be found to complete the restoration to airworthy standard of the Hurricane that has stood deteriorating for many years outside the chapel at Biggin Hill. This aircraft is currently loaned to the Medway Group of the Royal Aeronautical Society at Rochester, which is actively seeking funds to continue the restoration on behalf of the Royal Air Force and the nation.

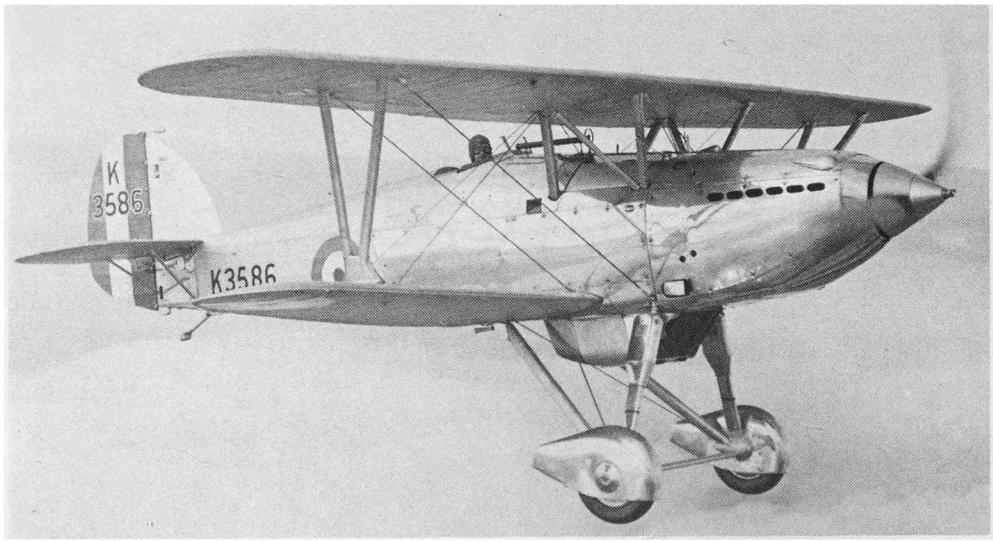
The Battle of Britain Memorial Flight is very proud to have the honour of commemorating the 'finest hour' of the Royal Air Force. Ours is a nation built on a great heritage and it is entirely fitting that a modern, forward-looking Royal Air Force should cherish its own priceless heritage. Furthermore, the Flight is more than just a living memorial to the men that gave the Royal Air Force the greatest battle honour in its history: it is a constant reminder to the people of this nation, and to all who see aircraft at the many public displays, of all that the Royal Air Force stands for. The motto of the Memorial Flight is a perfect epitaph: *'Lest We Forget'*.

Above:
Distinguished company: Spitfire PM631 poses with the US President's 'Air Force One' while at Cherbourg for the Normandy invasion anniversary of June 1984; and Sir Harry Secombe is helped into his suit by Flt Lt Nigel Brown prior to a ride with the Flight. *R. P. Evans*

Below:
En route to another display — Hurricane PZ865 and Spitfire XIX PS853. Behind them is a memorial of a different kind, Seething airfield in Norfolk.



The Hurricane Story



The Hurricane can be traced back to the Hawker design team of the early 1930s, led by Sir Sydney Camm. At that time the Hawker company already had a number of successful types in RAF service and had just produced the Fury, the ultimate bi-plane fighter. In the continuing quest for improvements, Camm conceived the idea for a radical new design, known at first as the Fury Monoplane. Although started as a private venture by the company, it soon attracted Air Ministry interest, particularly when Rolls-Royce released details of its new private venture engine, the PV12, which Camm elected to use in his new design. This enabled Hawker to release performance estimates for its new monoplane which, the Air Ministry realised, offered a chance to produced a fighter capable of dealing with the new generations of bombers then envisaged.

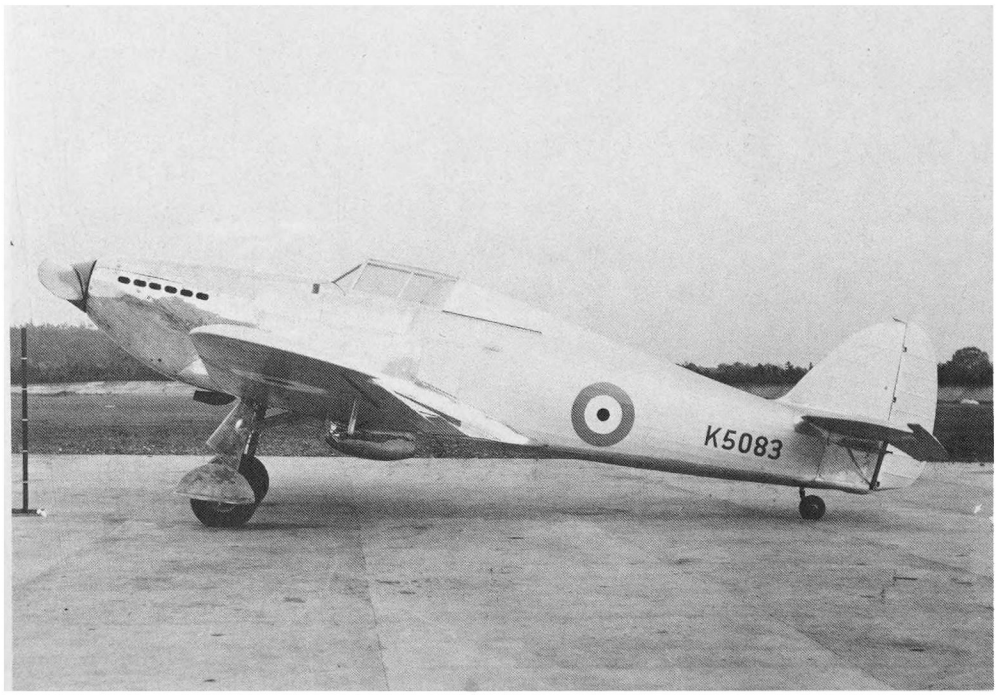
As a result a new Air Ministry specification (F36/34) was hurriedly drawn up, Camm made some minor adjustments to his design — such as retractable undercarriage — and in September 1934 Hawker submitted the 'Interceptor Monoplane' as its tender for the new specification. In February 1935 the company received a contract for one aircraft. This first aircraft was built at the Canbury Park Road works in Kingston-upon-Thames and taken by road to the Hawker plant at Brooklands in late October 1935. It was quickly re-assembled, and 14 days later, on 6 November 1935 in the hands of George Bulman, the silver-painted monoplane raced across the grass of Brooklands; K5083 took to the air for the first time.

Although the initial designs had four machine guns, the number was increased to eight following a reassessment of the fire-power needed against the bombers of the day. In June 1936 the first production order for 600 aircraft was placed, and the name Hurricane was officially approved shortly afterwards. The order was part of the Air Ministry's plans for increasing the strength of the RAF in the face of developments in Germany. The first production aircraft, L1547, flew from Brooklands in October 1937. The production aircraft differed very slightly from the prototype, primarily because the new Rolls-Royce engine, by then known officially as the Merlin, was altered and improved for the production versions. Numerous other airframe improvements were also embodied, and continued to be embodied, as production ran non-stop for the next seven years at factories in England and in Canada.

The first RAF squadron to be equipped with the Hurricane was No 111 Squadron at Northolt, which received the first of its new aircraft in December 1937. The Hurricane was the RAF's first operational fighter capable of exceeding 300mph in level flight. As the threat of war loomed, additional production facilities were opened; by September 1939, 475 Hurricanes had been delivered and by July 1940 the total had reached 2,309. The main factory, opened specifically for Hurricane production in 1939 and eventually producing over 7,000 aircraft, was at Langley, in Buckinghamshire. The Gloster works at Brockworth built nearly 3,000, over 1,000 were built by the Canadian Car & Foundry Corporation in Ontario, Canada, and Hurricanes were also built in UK car factories — the Austin Motor Co built 300 at Longbridge in 1941. When the last aircraft — PZ865 *The Last of the Many* — was rolled out at Langley on 27 July 1944, some 14,223 had been built.

Above:
The Hurricane lineage — the ultimate biplane was the Super Fury. *Flight*

Below:
The Hurricane prototype, K5083. Later its canopy was strengthened and the roundel enlarged. Brooklands race-track can be seen in the background. *BAe Kingston*



During the Battle of Britain in 1940, Fighter Command had 37 Hurricane squadrons. All but a handful of the Hurricanes that fought in the Battle were Mk Is with eight machine guns and the Merlin II engine, although those built in Canada were fitted with the Packard Merlin. While some flew only one sortie in the Battle before being lost or damaged, others such as P3395 flew unscathed with No 1 Squadron throughout. As a rugged, stable aircraft the Hurricane was popular with its pilots, and its construction made it much more survivable and easier to repair than the Spitfire. Although Hurricanes were credited with more kills during the Battle of Britain than all other defences combined, this was largely because there were almost twice as many Hurricanes in service as there were Spitfires.

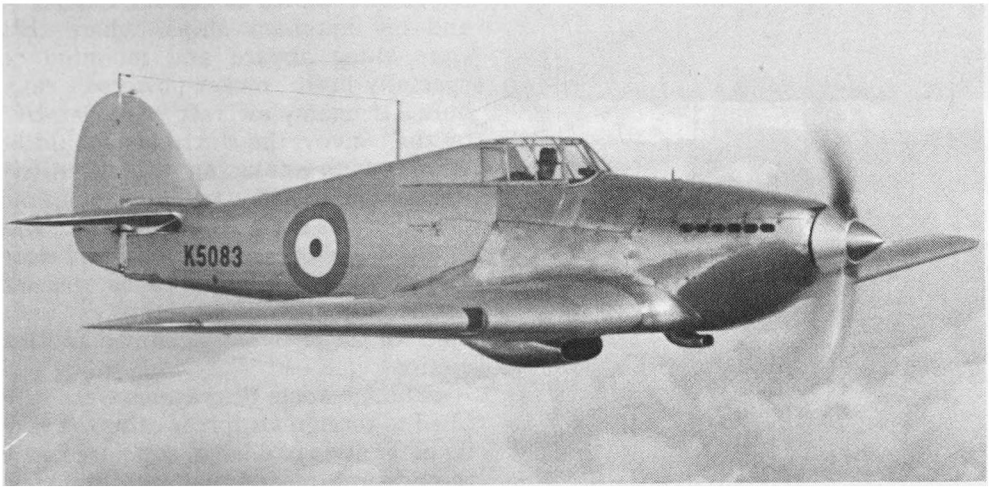
After the Battle of Britain the Spitfire became the mainstay of Fighter Command. Meanwhile the versatile Hurricane, with its strong, wide-track main gear and rough-field capability, was found to be much more suitable for overseas theatres, although several Hurricane squadrons continued in the night-fighter role in the UK. It was easier to maintain in field conditions and so the new variants coming off the Langley production line were designed specifically for operations in overseas areas. The Mk II versions were powered by the Merlin XX, giving some 20% more power than the Merlin II, and were used with great success in ground attack operations.

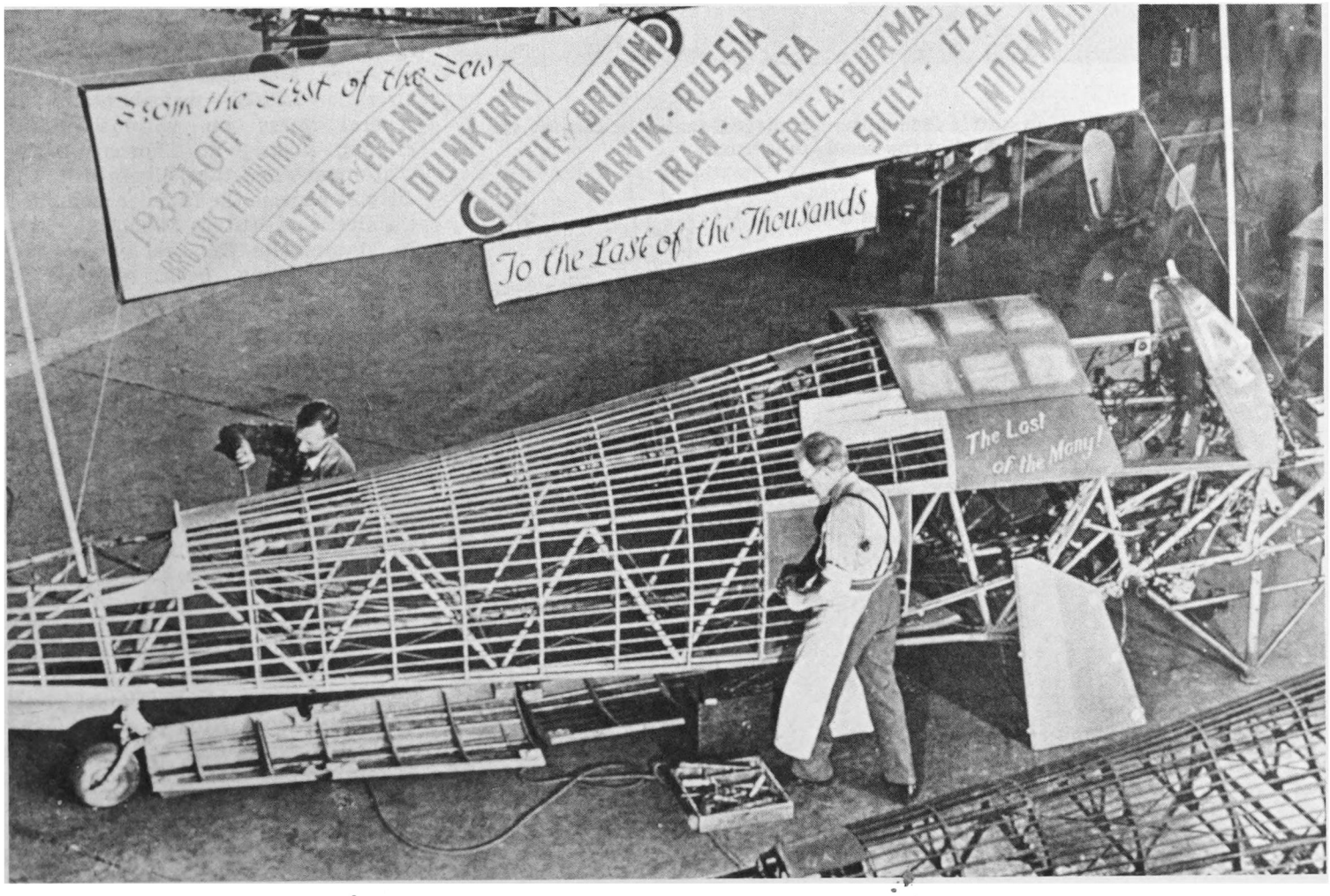
Mk IIA, like the Mk I, had eight machine guns, while the Mk IIB had 12, although the additional guns in the outer wing sections reduced the roll-rate slightly. The Mk IIC appeared in May 1941, with four 20mm cannon instead of machine guns, while the Mk IID, designed for anti-tank operations, carried two 40mm cannon in underwing pods. In due course the Mk IV appeared, fitted for bombs, cannon or eight 60lb underwing rockets.

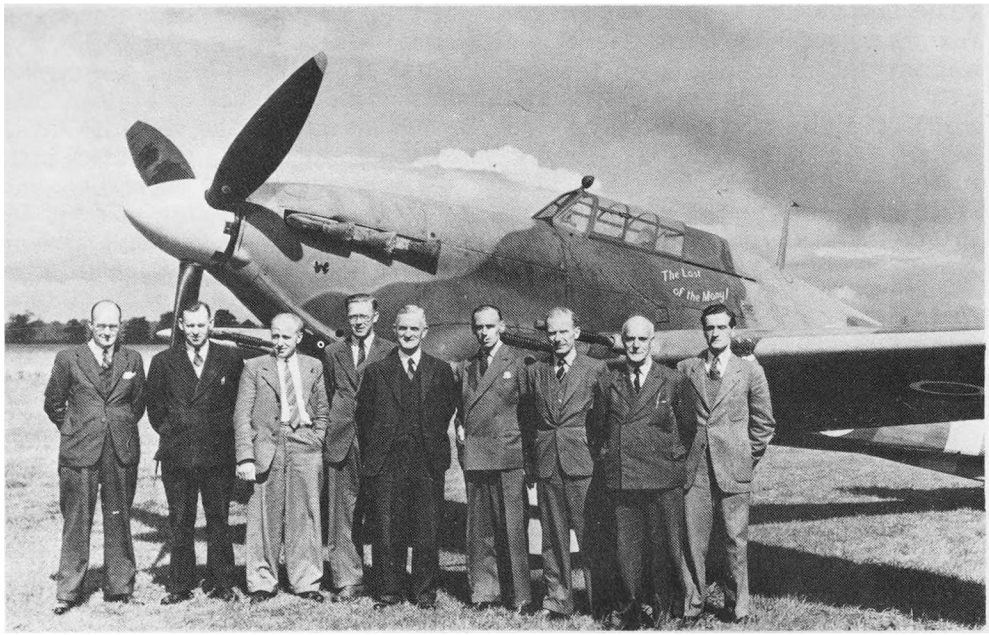
The Hurricane saw service in every theatre of the war. It was particularly successful in North Africa and it was

Below:
Hurricane prototype K5083 on a test flight. Note the addition of a radio antenna and test pilot George Bulman wearing his 'bowler'. *Flight*

Bottom:
***The Last of the Many* — PZ865 — under construction at Langley in 1944. The banner lists Hurricane 'battle honours'.** *Crown Copyright*





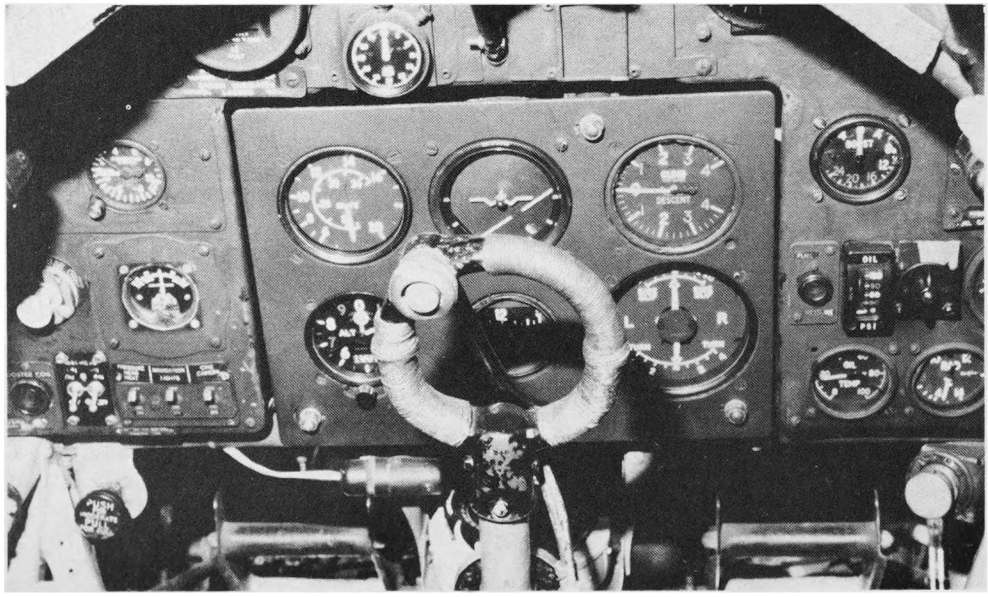




Top:
'PZ' with Hawker production staff in 1945. Although allegedly taken at Langley, the left background looks suspiciously like the Brooklands track.

Above:
A remnant of the Brooklands racing circuit in 1985.

Below:
Every attempt is made to maintain the Hurricane 'office' as close to the original as possible. The 'g' meter and stop-watch are necessary concessions to the Battle of Britain Memorial Flight task.



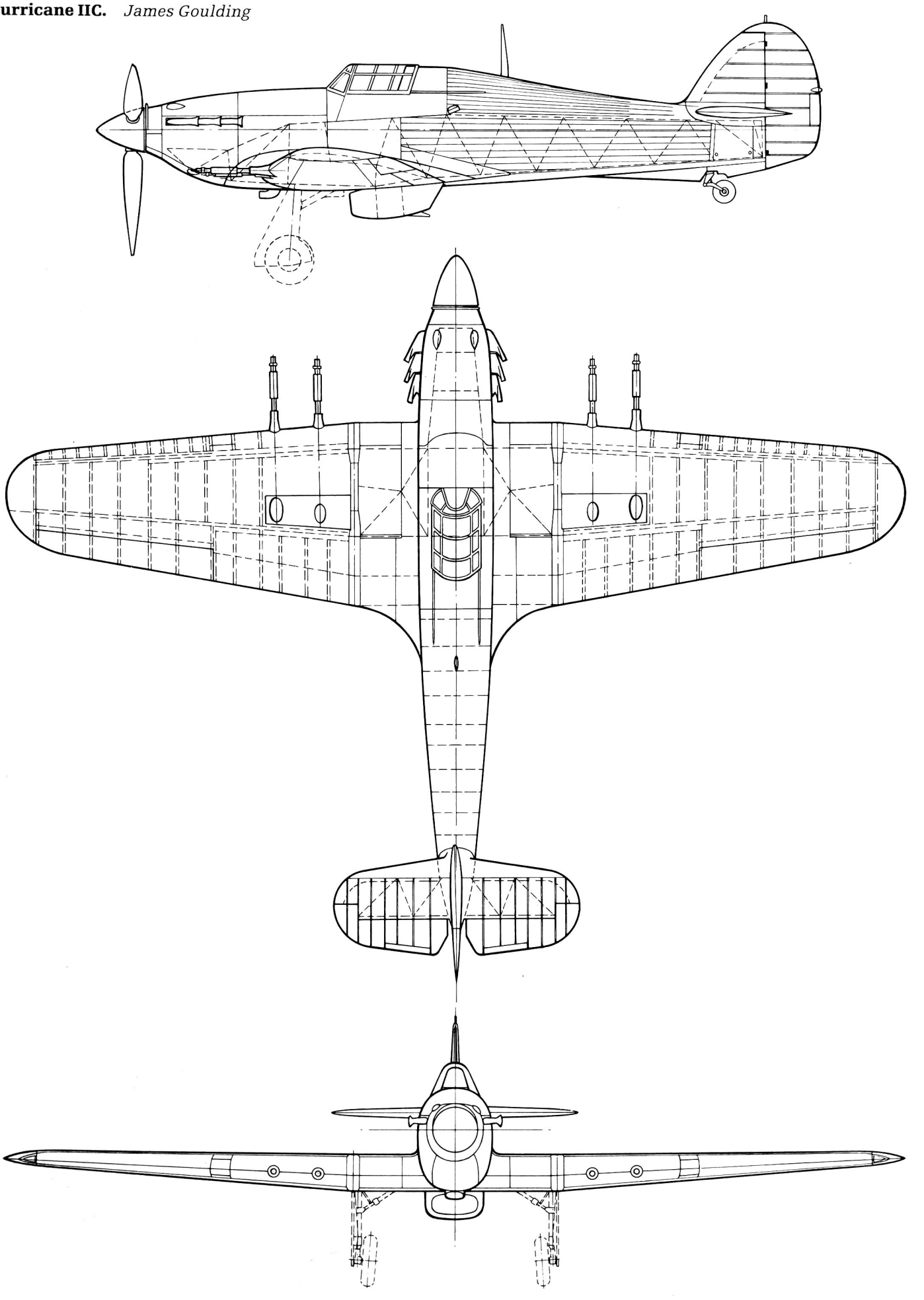
also used in the Middle East, in Iraq, India, Burma, the Far East and even in the Soviet Union. When Hitler turned his attention to the Eastern Front following the Battles of 1940, Britain despatched two squadrons — Nos 81 and 134 — with an initial batch of Mk IIB Hurricanes in August 1941. Within a few months the Russians had learned to operate the aircraft and, although the RAF personnel then returned home, over the next two years almost 3,000 Hurricanes were shipped to Russia — over 20% of all the Hurricanes built.

Hurricanes were also used at sea, both on carriers of the Royal Navy — when they were fitted with arrester hooks and known as Sea Hurricanes — and on merchant ships, where they were slung aboard and mounted on specially-built rocket-powered catapults. If enemy aircraft were detected by the convoy, the Hurricane would be launched to make an attack. Afterwards, if the aircraft could reach land the pilot was lucky; the alternative was to ditch or parachute into the sea close to the ship and hope to be rescued before other enemy sightings were made or the icy waters claimed another victim.

Although some Hurricanes were supplied to foreign air forces after the war, its older style of design, compared with the Spitfire, meant that its days were numbered. Gradually, during the late 1940s and early 1950s, the few remaining airworthy examples disappeared although, fortunately, one aircraft — LF363 — was maintained for several years on various Station Flights, mainly at Thorney Island, Waterbeach and then Biggin Hill. This aircraft became the founder member of the Battle of Britain Memorial Flight. Its stable-mate *The Last of the Many* (PZ865), having been retained by Hawker in 1944, spent several years in civilian colours before joining the Memorial Flight in March 1972. These two aircraft are currently the only airworthy Hurricanes left in the British Isles. A third aircraft — P3308, which was built in Canada in 1942 — was acquired and restored by the Strathallan collection in the early 1970s. This brought the world's total of airworthy Hurricanes to three.

The Royal Air Force, aviation and the nation owe a great deal to Sydney Camm and his team. Ever since 1928 the Royal Air Force has never been without a Camm-designed aircraft in front-line service — the latest is the Harrier. The Hurricane was beyond doubt the work-horse of the Battle of Britain and it is sad that it was so overshadowed by the Spitfire in the eyes of the public. For without the Hurricane, and its pilots, Britain would have lost the war.

Hurricane IIC. *James Goulding*



The Spitfire Story

It is doubtful if there will ever be another aircraft that will equal, both in the opinion of those who flew it and in the layman's consciousness, the reputation and charisma of the Spitfire — even though other fighters of World War 2 equalled it in performance and were more prolific destroyers of enemy aircraft; the Hurricane, for instance, accounted for three-fifths of all German aircraft downed by any means during the Battle of Britain. Perhaps above all is its appearance; the Spitfire is a work of art. From the beautiful elliptical wings to its graceful fuselage it looks right, and this fundamental rightness extends to all 36 Marks of Spitfire, from the Mk I weighing just over 6,000lb with a 1,000hp Merlin engine, to the Seafire Mk 47 (a modified Spitfire Mk 24) which weighed up to 12,750lb with a 2,500hp Griffon. Indeed, more variants of the Spitfire were developed than any other fighter in history.

How did it happen? Although many people may know that it was designed by R. J. Mitchell and that it had something to do with the Schneider Trophy racing aircraft, why did the Spitfire have such magic and how did it all come about?

R. J. Mitchell joined the Supermarine Aviation Works at Woolston near Southampton in 1916. Before the Great War ended he had designed his first aircraft, a fighter flying boat called the Supermarine Baby. A development of this machine, the Sea Lion I, was entered in the 1919 Schneider Trophy race but it was damaged on take-off and could not compete. In 1922, however, Mitchell returned to the fray with the Sea Lion II and won; the next year the Mk III version was beaten by the Americans with their Curtis seaplanes. This defeat had a profound effect on Mitchell; he saw clearly that the future for the Schneider racing machine lay in a float plane. The flying boat had had its day as a high speed aircraft, but whilst the rest of the aviation world was thinking biplanes, Mitchell was thinking of a monoplane. Fortuitously the Air Ministry had decided to back development of a high speed aircraft, thus releasing enough money to produce the first of the Supermarine racing seaplanes — the S4 — which took part in the 1925 race. It crashed because of wing flutter. Britain did not compete in 1926, but in 1927 Mitchell was back with his S5, which was a much-developed S4. This time the wings were wire braced! Flown by pilots of the newly formed RAF High Speed Flight, the aircraft won convincingly. There was no race in 1928, but in 1929 Mitchell's S6 won an exciting contest. By then the country was in economic difficulties and the Government withdrew all funding for an attempt to achieve a third decisive victory. Everything appeared very bleak until at a late stage Lady Houston presented £100,000 to promote the entry. It was too late to design a complete new machine so a refined S6 — the S6B — was produced and entered. It won by a walk-over, and in September of that year pushed the world speed record up to 407.5mph. The scene was set for the Spitfire.

During the excitement of the Schneider era, Supermarine's more usual work was the design and construction of flying boats. When the races lapsed after the 1929 victory, Mitchell and his design team felt that their hard won experience with the racers ought to be put to use in the design of a high speed fighter. So when the Air Ministry issued Specification F7/30 for a four-gun day and night fighter to replace the Bristol Bulldog, Supermarine responded with the company's Type 224. It was a failure, due as much to limitations in the specification as design faults. Nevertheless, Mitchell was aware of its shortcomings even before the first flight and already had something better on the drawing board. This new design had, for the first time, a retractable undercarriage and an enclosed cockpit. It was never built and neither was a subsequent, more refined, design, both of which featured the Rolls-Royce Goshawk engine. Although metal was never cut, both designs were important milestones on the road to Mitchell's private venture Type 300.

Early in the course of this aircraft's creation another private venture came on the scene in the shape of the Rolls-Royce liquid-cooled PV12 engine, soon to be called the Merlin, which Mitchell elected to use in the Type 300. The potential of this combination so





impressed the Air Ministry that it virtually wrote specification F37/34 around it, whilst also incorporating some unusually advanced thinking about the fire-power requirements of a new fighter: the specification called for eight machine guns, each firing 1,000 rounds per minute. It was, therefore, a formality when Vickers Supermarine was given Government funding to build a prototype aircraft to this design. Thus was conceived the Spitfire, as the Type 300 had by then become known.

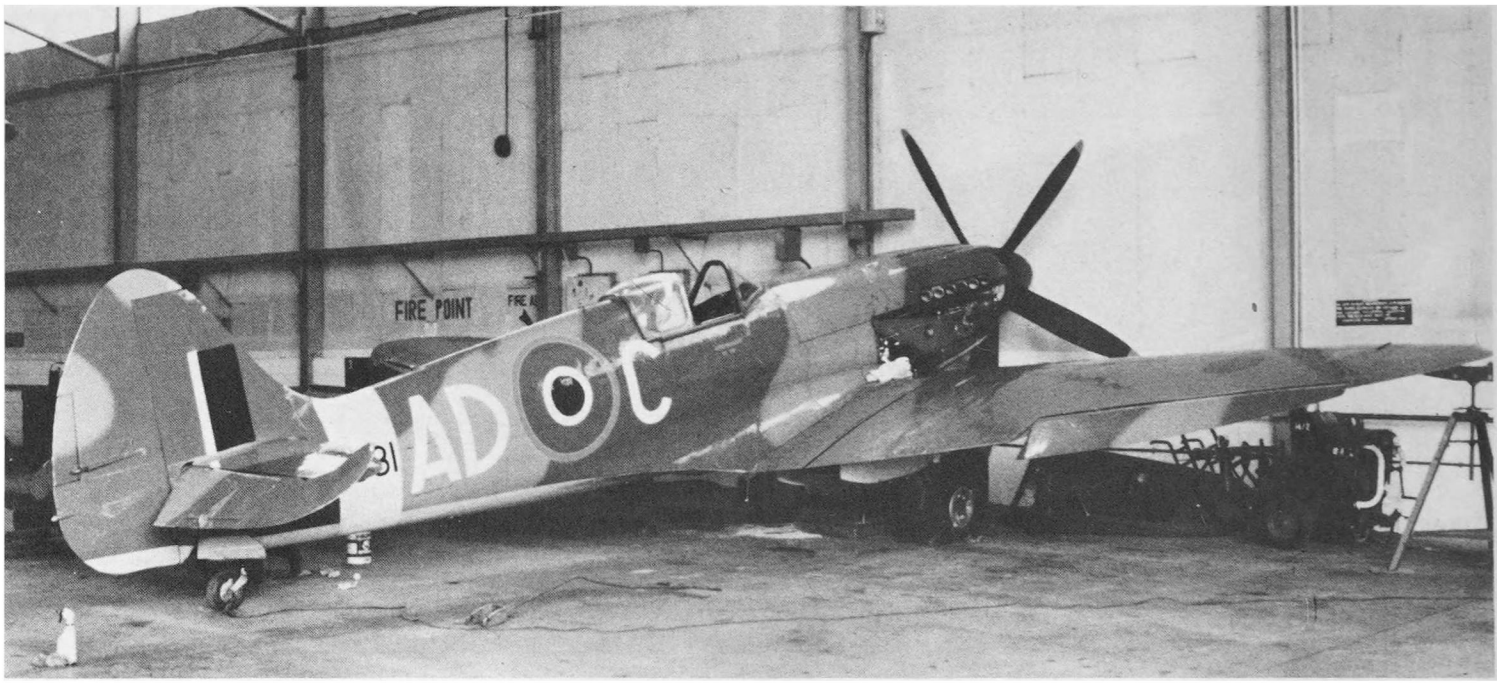
It is interesting to reflect that if the aircraft companies had designed and built only to the official Air Ministry requirements or specifications, the RAF may well have entered World War 2 still equipped with biplane fighters. In those days the time from conception of an aircraft project to first flight was, fortunately, less than it is today, and on 5 March 1936 prototype Spitfire K5054 was ready for its first flight. This took place from Eastleigh airfield close to Southampton and was flown by J. ('Mutt') Summers, Vickers' chief test pilot at the time. It was immediately clear that something rather special had been produced and within a short time Air Ministry Specification F16/36 had been issued which resulted in a contract, signed on 3 July 1936, for 310 production standard Spitfires to be in

Below left:
Spitfire Mk XVI TE476 at Bentwaters 16 May 1959, showing clearly the tear-drop canopy and rear-view fuselage. Although grounded and disposed of in January 1960 after only two years on the Flight, it enjoyed a brief rejuvenation when restored to taxy standard for the *Battle of Britain* film. *C. F. E. Smedley*

Above:
Mk XIX PM631 shows its big twin radiators at Biggin Hill in 1965. PS853 is just visible on the left.

Below:
PM631 in her element — flying escort on the Lancaster. *R. P. Evans*





Above:
PM631 out of her element — in late 1982, before invasion stripes were added.
Tom Dean

service by March 1939. This was a colossal order by Vickers' standards and quite beyond the company's production capacity. As a result, it was necessary to introduce into the design the ability for it to be produced in component form by numerous subcontractors. This feature assumed great importance when, later during the war, it became necessary to disperse the factories producing Spitfire components over a wide area of Southern England, to escape the attention of German bombers.

Tragically Mitchell died of cancer at the age of 42 and never saw his prodigy in production. Had he lived perhaps his genius would have achieved even greater triumph, as in the case with his contemporary at Hawkers, Sydney Camm.

The first production aircraft to enter service was K9789. It joined No 19 Squadron at Duxford on 4 August 1938 and was followed at weekly intervals by others. This production rate soon began to accelerate; by the end of the year both Nos 19 and 66 Squadrons at Duxford were at their full strength of 16 aircraft each. When war was declared on 3 September 1939, 400 Spitfires were in service, with additional orders totalling 2,160. Fortunately, because of the limited capacity at Woolston, it had been decided in 1937 to build a new factory at Castle Bromwich near Birmingham. Later, in 1940, it came under the aegis of the new Ministry of Aircraft Production. With Lord Beaverbrook as the driving force, the first aircraft from Castle Bromwich entered service on 6 June 1940 and from this point the delivery rate of Spitfires was soon doubled. Aircraft produced by the new factory were designated Mk II, and they incorporated all the design improvements retrofitted to the Woolston Mk Is, such as a bulged cockpit canopy to improve the pilot's all-round vision. They also had the slightly more powerful Merlin XII engine.

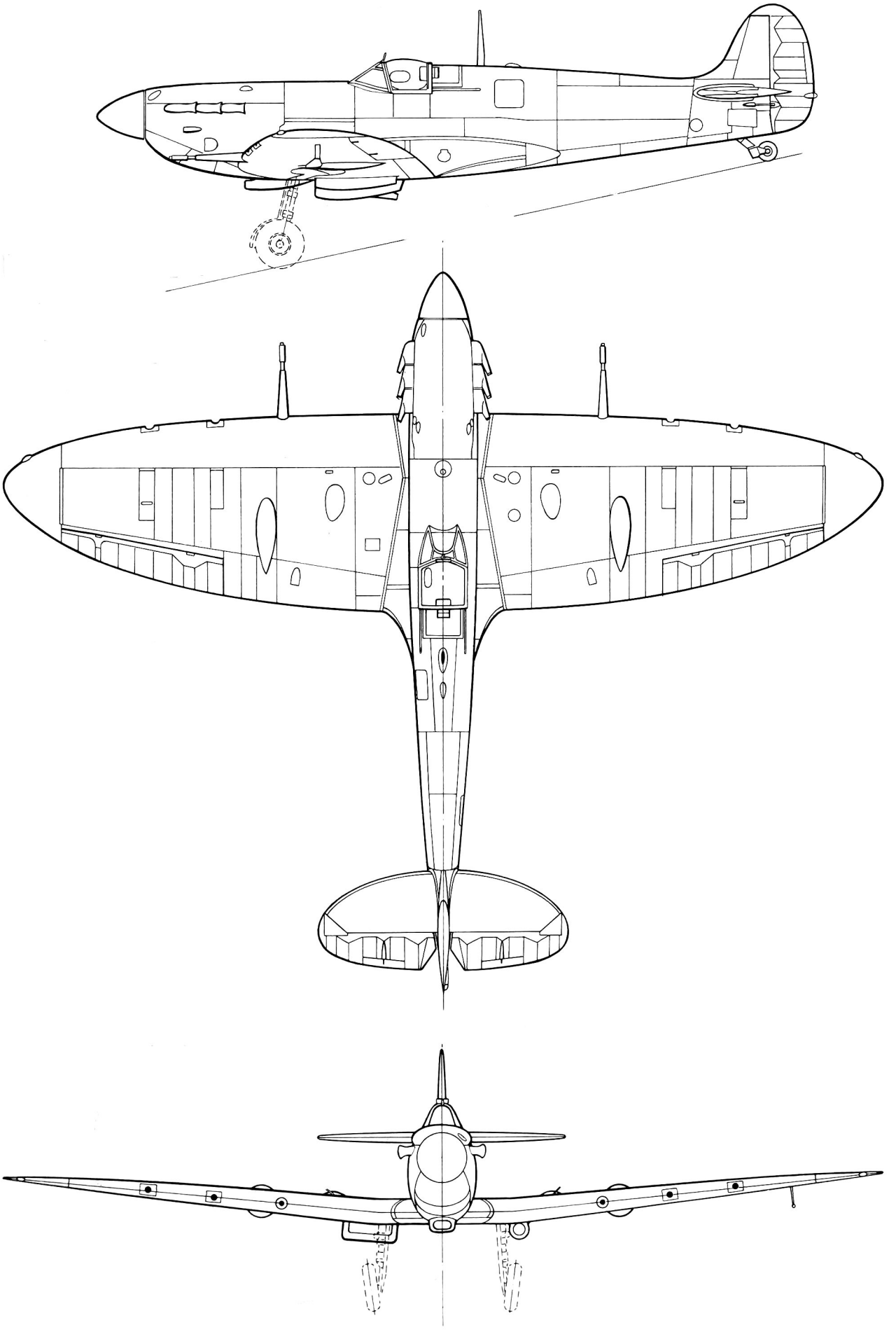
The Mks I and II were the Spitfires with which the RAF fought the Battle of Britain. During the Battle it had been found that the Mk Is were too vulnerable to the Bf109s and they were withdrawn from operations in January 1941. By then, however, the Germans had introduced the improved Bf109F, which outclassed even the Mk II Spitfire. The RAF's answer was the Mk V (the Mks III and IV never entered service). This was essentially a Mk II with a 12% more powerful engine (Merlin 45) and a strengthened fuselage to cope with the extra stress imposed. In fact it was possible to convert Mk IIs on the production line to Mk V standard before they were completed. Perhaps the most significant advance on the Mk V was the introduction of metal-skinned ailerons, which largely restored the roll-rate at high speed.

At first the Mk Vs were fitted with the usual eight machine guns. However, it was apparent even from the earliest stages of the war that the cannon was a better gun for air combat. Although it had a lower rate of fire, its heavier explosive shell and high muzzle velocity was far more destructive and could be used at a greater range. Early attempts to arm Mk Is with Hispano cannon were unsuccessful because ammunition feed failures and icing caused frequent stoppages. By late 1941 these problems had been overcome and the Hispano cannon was then fitted to the Mk Vs. Such aircraft were designated Mk Vb and generally had four 7.7mm Browning machine guns and two 20mm cannon. Later versions with a redesigned wing could carry four cannon and were designated Mk Vc. This redesigned wing was to become known as the Universal Wing; it could mount almost any combination of guns and, by the manipulation of a few bolts at the wing tips, could become an extended high-altitude wing, a normal Spitfire wing or a clipped wing for use at lower levels.

More Mk Vs were built (some 6,500) than any other Mark of Spitfire and were the first to be converted for use by the Royal Navy, which called it the Seafire Mk I. This Mark also saw service in the air forces of the United States, Australia, Portugal, Egypt, France, Greece and Russia. The photo-reconnaissance and specialist high-flying versions of the Mk V were the VI and VII. When the German FW190 appeared on the scene the Spitfire was again outclassed and remained so until the advent of the Mk IX Spitfire. This essentially was a re-engined Mk V, strengthened to cope with the 1,500hp of the new Merlin 61 — the Mk IX was an outstanding aircraft, considered by many to be the best of all the Spitfire variants — and when powered by the American-built Packard Merlin it was designated Mk XVI.

The next major milestone in Spitfire development was the Mk XIV which, in 1943, was the first of the breed to be put into quantity production powered by the 2,000hp Rolls-Royce Griffon engine. (Although the Mk XII was the first to enter service with this engine, only 100 were built.) The Mk XIV was a powerful beast and was to prove most effective against the V1 Doodle-Bug attacks in the closing stages of the war in Europe.

Spitfire VB. *James Goulding*



Both the Mk XVIII and PR XIX were very closely related variants.

The final stages in Spitfire development, marked by the F21, F22 and F24, involved a radical redesign of the airframe in which the wing lost its classic elliptical planform and the fin and rudder became so large to counter the power of the engine that they appeared out of proportion with the rest of the fuselage.

The navalisation of the Spitfire, as the Seafire, has already been mentioned. Its development closely followed the parent aircraft and, altogether, eight Marks were produced, with the final one being designated FR47. This was, in fact, the naval version of the F24 Spitfire.

Apart from an unsuccessful development of the Spitfire called the Spiteful (naval Seafang), the type's story ended in the shadow of the new jet fighters. However, the Spitfire had become a legend very early in its lifetime and was the only Allied fighter to remain in production throughout the entire war — it is doubtful if there will ever be another aircraft so identified with the fate of a nation. It is to be hoped that the Battle of Britain Memorial Flight is able to display this beautiful machine to the public for many years to come.



Above:
This comparison of Spitfires Mk II and Mk XIX (P7350 ZH-T and PM631 AD-C) shows the significant external changes made during the development process — note the Griffon engine, increased fin area, a retractable tailwheel and an additional radiator. *CPG*

Spitfire development

Mk I Original production model. Fitted with 8×7.7mm Browning machine guns and a Merlin II or III of 1,030hp. Subsequently designated Mk Ia.

Mk Ib Armed with 2×20mm cannon and 4×7.7mm machine guns. Total of 1,566 Mk 1s of all types built.

Mk IIa Similar to Mk Ia, built by Castle Bromwich. Had 8×7.7mm machine guns with 1,175hp Merlin XII. 750 built.

Mk IIb Armed with 2×20mm cannon and 4×7.7mm machine guns. 170 built.

Mk IIc IIa adapted for air sea rescue duties.

Mk III One prototype only with a 1,340hp Merlin XX and retractable tailwheel.

Mk IV One prototype with Griffon II engine.

PR IV Photographic reconnaissance version of Mk V with extra fuel tanks in place of the armament. Merlin powered, 229 built.

F Va Strengthened Mk I or Mk II with 8×7.7mm machine guns and 1,470hp Merlin 45. 94 built.

LF Va F Va with clipped wings (32ft 2in span) and low-altitude rated Merlin for low level work.

F Vb Strengthened Mk Ib with Merlin 45. 3,923 built.

LF Vb F Vb with clipped wings.

F Vc Strengthened Mk I or Mk II with 'c' Universal Wings. 2,447 built.

LF Vc F Vc with clipped wings.

HF VI High altitude interceptor based on Mk V, with pressurised cabin to catch high-flying Ju-86P raiders. 40ft 2in wingspan with pointed tips; 2×20mm cannon and 4×7.7mm machine guns. 100 built.

F VII High altitude interceptor based on a strengthened Mk VI to take a two-stage Merlin 61/64/71. Incorporated modified ailerons, retractable tailwheel and individual exhausts. 140 built.

PR VII Armed (8×7.7mm) photographic reconnaissance version of Mk V.

Mk VIII The definitive Merlin-engined Spitfire, specifically designed for the Merlin 61/66 series engine of 1,660hp and principally used in the Mediterranean and the Far East. Basically an unpressurised VII with further strengthening, some had enlarged fins and rudders. Choice of LF, F or HF wings. First large-scale production version with retractable tailwheel and twin radiator. 1,658 built.

T VIII Two-seat trainer, converted from Mk VIII.

Mk IX Mk V hastily adapted to take the new 1,660hp Merlin 61/63 engine to counter the new FW190. Most had extended fin and broad-chord rudder, with a choice of LF, F or HF wings. Some armed with 2×20mm cannon and 2×0.5in machine guns. 5,666 built.

PRX Pressurised version of PR XI, unarmed. 16 built.

PR XI Unarmed reconnaissance aircraft adopted from Mk IX. Some with modified fin and rudder and retractable tailwheel.

Mk XII Low level interceptor designed to catch FW190 hit-and-run raiders over Southern England. Powered by Griffon III or IV of 1,735hp, Mk XIIs were basically converted Mk IX or VIII depending on the batch, with enlarge nose cowlings to take the bigger Griffon. 100 built.

Mk XIII Converted Mk V airframes for low level photographic reconnaissance with a Merlin 32 and 4×7.7mm. 18 built.

Mk XIV Redesigned and strengthened Mk VIII to take a Griffon 65/67 of 2,035hp, with an enlarged fin and rudder to cope with the increased power and also symmetrical radiators. Some had teardrop canopy. 327 built.

FR XIV Modified XIV with rear fuselage fuel tanks and camera installed, clipped wings and tear-drop canopy.

Mk XV Reserved for the Seafire series.

Mk XVI Mk IX with 1,580hp Merlin 266 (Packard Merlin) and rear fuselage fuel tanks. Most had tear-drop canopy.

Mk XVII Reserved for Seafire series.

Mk XVIII Definitive Griffon-engined fighter. Mk XIV with a new wing. 2×20mm cannon and 2×0.5 machine guns.

FR XVIII XVIII with cameras and reduced fuel.

PR XIX Unarmed PR version. Griffon 65 of 2,035hp. 225 built. Basically a late Mk XIV with Mk Vc bowser wing — 66gal in each wing in place of guns.

Mk XX Rebuild of the Mk IV and prototype XII. Only one built.

F21 Redesigned fuselage with original style hood and a new wing shape. Powered by a 2,035hp Griffon with 4×20mm cannon; some with contra-rotating propellers (Griffon 85). 122 built.

F22 F21 with tear-drop canopy, larger tail surfaces and 2,3754hp Griffon. 278 built.

F24 F22 with minor improvements and rear fuselage fuel tank. 81 built.



Above:
Hurricane PZ865 *The Last of the Many* with Spitfire P7350 SH-D en route from Manston to Coningsby on 30 September 1982. *Richard Winslade*

Below:
Wg Cdr John Ward flying Spitfire P7350 in 1985. The aircraft is carrying the EB-Z *Observer Corps* codes.
Richard Winslade



Immortal Power

The Story of the Merlin

An often overlooked but very simple fact is that without the Merlin engine, neither the Hurricane nor the Spitfire could possibly have been ready in time for the Battle of Britain.

It was a most fortunate coincidence in 1933, as Camm and Mitchell were evolving the designs of their magnificent fighters, that Rolls-Royce was developing as a private venture a new engine which would provide the power needed for the next generation of fighter aircraft. The company already had a long history of successful aero engine designs and its aim was to produce an engine that would be a significant advance over the Kestrel — which powered the Fury fighter at the time — and also made use of the invaluable lessons learned in the development of the highly-tuned 'R' engines of the Schneider Trophy racing float-planes. As with R. J. Mitchell and the Spitfire, Sir Henry Royce — who led the Rolls-Royce team and was entirely responsible for the private venture — never knew of the impact his genius would have on his country. He died just before initial testing began.

The new engine, known as the PV12 — PV for private venture — was to be a 60° 'V' layout with 12 cylinders. It had as its predecessors the Eagle engine (which had powered Alcock and Brown across the Atlantic) followed by the Condor and then the Kestrel. The early development testing of the PV12 was done in a Hawker Hart and a Horsley, which enabled the teething problems to be quickly overcome; in November 1935 the prototype Hurricane flew for the first time with the new Merlin, as the PV12 was then called. This 1,000hp, 27-litre engine also powered the Spitfire prototype on its first flight the following March.

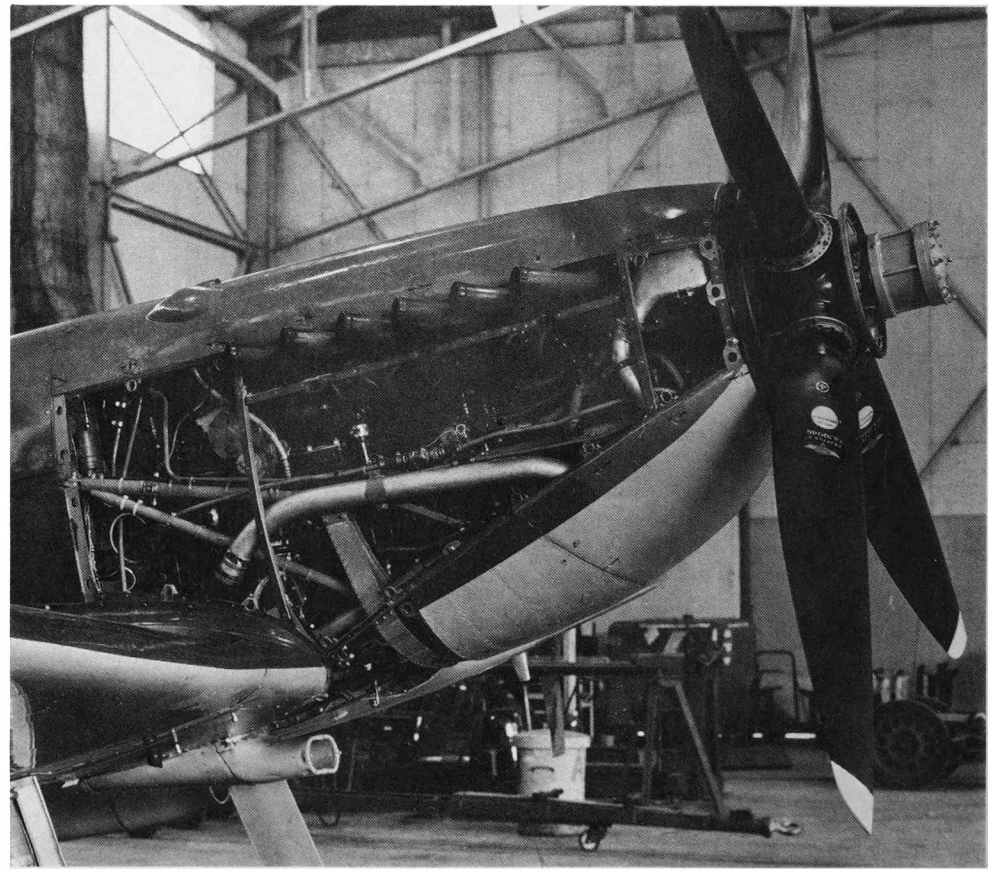
By September of 1936, Rolls-Royce had decided that the Merlin I engine of those prototypes would not be put into full-scale production and the early production Hurricanes and Spitfires were powered instead by the much-improved Merlin II. This first production version of the Merlin had different mountings, controls, air intake and rocker boxes and an improved hand starter.

The Mk I Hurricanes and Spitfires of 1938 and 1939 were powered by Merlin IIs and IIIs but, to the eternal credit and foresight of the Rolls-Royce design team, the engine was already demonstrating its enormous development potential. As fast as Daimler-Benz and BMW were able to improve the engines of the Bf109 and FW190, Rolls-Royce was always ready with the next Merlin development. The Merlin XX fitted to the Hurricane Mk II gave nearly a 20% increase in power and, by 1941, when the Mk V Spitfire entered service, its Merlin 45 gave over 40% more power than the prototype.

This was to be the continuing feature of Merlin and Spitfire development — the one complementing the other perfectly. But it must not be overlooked that the Merlin also provided the power for the Wellington, the Halifax, the Lancaster, the Mosquito and many others. Built under licence in the USA, Packard Merlins poured off the Detroit production lines from late 1941 to enable US-built fighters such as the Mustang to become so successful. Whereas the German engineers obtained more power for the Bf109s and FW190s by increasing maximum engine rpm, Rolls-Royce decided to retain the rpm limits and increase manifold boost pressure instead. This allowed significant increases in output power but kept major modifications to a minimum and avoided disruption of production lines. The Merlin engine was developed, broadly speaking, in three varieties, each identified by its supercharger — the single-speed supercharger engines of the Merlin II/III and 45 types, the two-speed single-stage supercharger engines of the Merlin X and XX series, and those with two-speed two-stage superchargers of the Merlin 61 and 63 types.

By 1944 the engine had been developed to give almost twice its original horsepower and take +25lb of boost, allowing the Spitfire to remain a potent match for its adversaries. Nevertheless, earlier, in 1942, Rolls-Royce had recognised that even the Merlin would soon reach the limit of its development and the company turned to the Griffon instead. The Griffon, initially conceived to meet Fleet Air Arm requirements for a torpedo-bomber, was essentially similar to the Merlin but had a displacement of 36.7 litres, which was the same as the racing 'R' engines of the Schneider float-planes. First fitted to the Mk XII Spitfire, it restored the Spitfire's superiority over the FW190, and Griffon-powered Spitfires were the fastest of all variants. Even so, of the total of over 20,000 Spitfires built, almost 90% were Merlin powered.

The Memorial Flight often receives letters telling how the sound of its aircraft, as they fly overhead, has brought people running from their homes, caused time to stand still, eyes turned skywards in a mixture of memories and emotion, pride and wondering. There can be few more evocative sounds in this life than the song of a Merlin.



Rolls-Royce Merlin

Model: Merlin XX
Type: 12 cylinders, vee 60°, pressure water cooled, geared drive, supercharged, four-cycle.
Construction: Two-piece aluminium alloy crankcase, two aluminium alloy cylinder blocks with integral heads. Steel cylinder liners. Two inlet valves and two exhaust valves (sodium cooled) per cylinder actuated by overhead camshaft. Six-throw one-piece counterbalanced crankshaft supported in seven plain bearings. Spur reduction gear, ratio 0.42:1.
Supercharger: Gear driven two-speed supercharger, ratios 8.15:1 and 9.49:1.
Carburation: One SU AVT-40 two-barrel updraft carburettor with automatic mixture control and boost control.
Ignition: Two BTH C5SE12-S or Rotax NES12-4 magnetos, two 14mm short reach spark plugs per cylinder. Shielded ignition system.
Lubrication: Pressure feed, 70lb/sq in (4.9kg/sq cm). Dry sump.
Starter: BTH CA4750 electric starter.

Bore: 5.40in (137mm)
Stroke: 6.00in (152mm)
Displacement: 1,649cu in (27.0 litres)
Compression ratio: 6.0:1
Width: 29.8in (757mm)
Height: 41.2in (1,046mm)
Length: 70.6in (1,793mm)
Frontal area: 5.8sq ft (0.54sq m)
Weight: 1.450lb (658kg)
Weight/horsepower: 0.98lb/hp (0.44kg/hp)
Fuel consumption (cr): 0.52lb/hp/hr (235g/hp/hr)
Oil consumption (cr): 0.022 lb/hp/hr (10g/hp/hr)
Gasoline grade: 100/130 (DED 2475) (100/130 grade)
Oil grade (viscosity): 100 SU (DTD 472-B) (20.5cs)
Output/displacement: 0.90hp/cu in (54.8hp/litre)
Output/piston area: 5.38hp/sq in (0.83hp/cm)
Piston speed (max): 3,000ft/min (15.2m/sec)
Bmep (max): 238lb/sq in (16.7kg/sq cm)
Rating (take-off): 1,280hp/3,000rpm/54.3in (1,380mm) Hg boost
Rating (military, low): 1,480hp/3,000rpm/6,000ft (1,800m)
Rating (military, high): 1,480hp/3,000rpm/12,500ft (3,800m)
Rating (normal, low): 1,240hp/2,850rpm/10,000ft (3,000m)
Rating (normal, high): 1,175hp/2,850rpm/17,500ft (5,300m)
Rating (cruising, low): 1,100hp/2,650rpm/9,250ft (2,800m)
Rating (cruising, high): 1,040hp/2,650rpm/16,000ft (4,900m)



Merlin X
1,075hp/3,000rpm/take-off; 1,130hp/3,000rpm/5,250ft (1,600m) and 1,010hp/3,000rpm/17,750ft (5,400m) military rating; 1,035hp/2,600rpm/2,250ft (700m) and 960hp/2,600rpm/13,000ft (4,000m) normal rating. Reduction gear ratio 0.42:1. Two-speed one-stage supercharger, ratios 6.39:1 and 8.75:1. 87-octane gasoline.

Merlin 21, 22, 23, 25
Similar to Merlin XX.

Merlin 28, 29, 31, 33, 38
Similar to Merlin XX. Built by Packard Motor Car Co in the United States of America.

Merlin 55
Similar to Merlin XX.

Rolls-Royce Griffon

Model: Griffon 65.
Type: 12 cylinders, vee 60°, pressure water cooled, geared drive, supercharged, four-cycle.
Construction: Two-piece aluminium alloy crankcase. Two aluminium alloy cylinder blocks with a detachable head for each block. Steel cylinder liners. Two inlet valves and two exhaust valves (sodium cooled) per cylinder actuated by overhead camshaft. Six throw one-piece counterbalanced crankshaft supported in seven plain bearings. Spur reduction gear, ratio 0.45:1 or 0.51:1. Rotol remote drive gearbox for accessories. Equipped for Rotol five-blade constant speed variable pitch propeller.
Supercharger: Gear-driven two-speed two-stage supercharger, ratios 5.84:1 and 7.58:1. Automatic gear change at critical altitude. Water-cooled inter-stage passages. Water-cooled after-cooler.
Carburation: One SU AVT-140 two-barrel updraft carburretor with automatic mixture control and progressive boost control.
Ignition: One BTH CSH 12.12S/4 dual magneto, two 14mm short reach spark plugs per cylinder shielded ignition system.
Lubrication: Pressure feed, 45-60lb/sq in (3.2-4.2kg/sq cm). Direct feed to all crankshaft main bearings. Dry sump.
Starter: Plessey Coffman 1.3/1HT cartridge starter, or approved electric starter.

Bore: 6.00in (152mm)
Stroke: 6.60in (168mm)
Displacement: 2,240cu in (36.7 litres)
Compression ratio: 6.0:1
Width: 29.5in (750mm)
Height: 46.0in (1,168mm)
Length: 81.0in (2,057mm)
Frontal area: 6.6sq ft (0.61sq cm)
Weight: 2.090lb (948kg)
Weight/horsepower 1.04lb/hp (0.47kg/hp)
Fuel consumption (cr): 0.50lb/hp/hr (225g/hp/hr)
Oil consumption (cr): 0.022lb/hp/hr (10g/hp/hr)
Gasoline grade: 100/130 (DED 2475) (100/130 grade)
Oil grade (viscosity): 100 SU (DTD 472-B) (20.5cs)
Output/displacement: 0.89hp/cu in (54.5hp/litre)
Output/piston area: 5.89hp/sq in (0.91hp/sq cm)
Piston speed (max): 3,025ft/min (15.4m/2sec)
Bmep (max): 256lb/sq in (18.0 kg/sq cm)
Rating (maximum): More than 2,000hp/2,750rpm

Griffon 66
Similar to 65 but with cabin supercharger for Spitfire PR XIX.

Note: Griffon 65 powered the Spitfire XIV. The Rolls-Royce Griffon has the same displacement as the Rolls-Royce 'R' racing engine which won the Schneider Trophy outright in 1931. the 'R' engine was rated at 2,600hp/3,000rpm/sea level at 67.0in (1,702mm) Hg boost with a bmep of 310lb/sq in (21.8kg/sq cm) using 92-octane gasoline.

Left:
The smooth lines of AB910's Merlin compared with the long bulge on the upper cowling of PM631 to accommodate the cam-shaft housing of the much larger Griffon 66. Here PM631 is being prepared for the flight over Central London on 5 March 1986 to mark the 50th anniversary of its first flight.
Crown Copyright




BBMF
BBMF





Left:
Hurricane LF363 in the night-fighter finish of No 85 Squadron. Here Wg Cdr John Ward is flying the aircraft over Lancashire on 20 June 1985, en route from Warton to Brize Norton. *British Aerospace*

Below:
A fine shot of Spitfire AB910 as XT-M in 1983. *Allan Burney*





Far left:
Spitfire AB910 during post-servicing/pre-season ground runs in 1985. *Vince Carter*

Left:
Spitfire PM631 on display at North Weald in July 1985. *Pete Jeffrey*

Maintaining the Heritage

The Engineer's Story

The Hurricanes and Spitfires of the Battle of Britain Memorial Flight (BBMF) are maintained by a dedicated, permanent team of 12 engineers, mainly volunteers drawn from the many and varied engineering sections which normally support the fleet of Phantom and Tornado aircraft at Coningsby. There is never a shortage of tradesmen wishing to join BBMF and, having become members of the servicing team, few ask to be returned to normal duties, despite the long hours worked, the many disrupted weekends and most public holidays spent away at air displays — indicative perhaps of the tremendous job satisfaction that the engineers enjoy!

Formal training opportunities no longer exist to teach the intricacies of these historic aircraft and their equally famous Rolls-Royce Merlin or Griffon engines, therefore newcomers to the Flight undergo 'on-the-job' training and instruction, where knowledge and experience gained since BBMF's formation 29 years ago is passed on. Generally speaking it takes six to nine months of training to bring someone to a standard where they are considered competent to work with minimal supervision, which is most important when taking into account the small number employed as tradesmen.

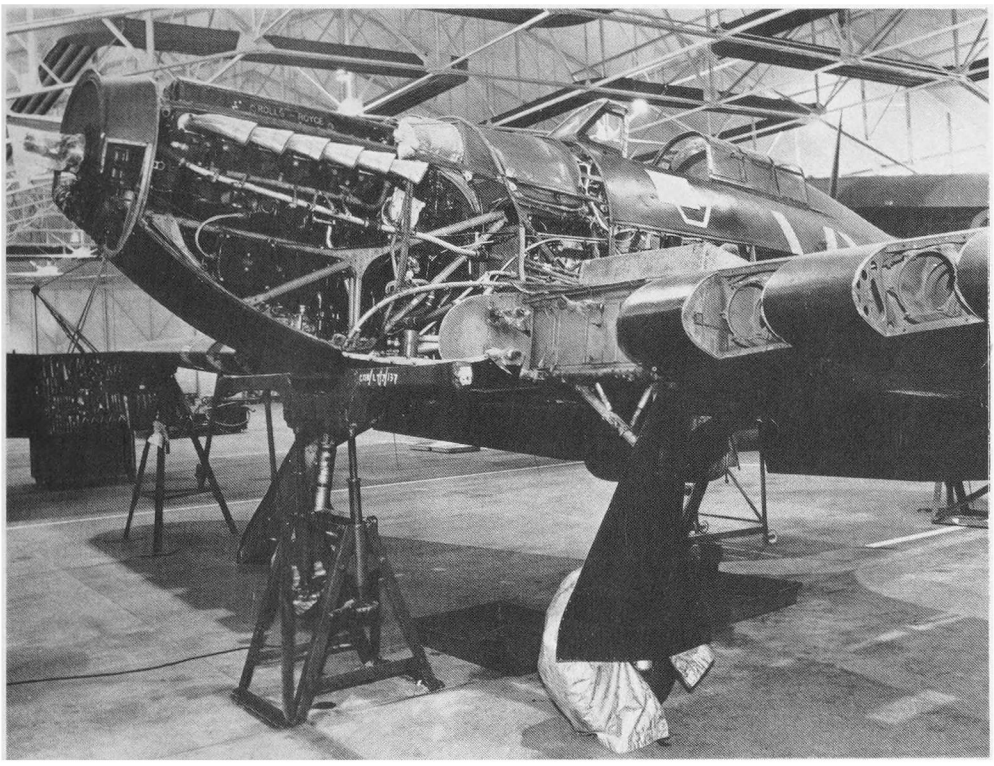
Although it is by no means comprehensive, the Flight has a considerable reference library of Air Ministry publications, manufacturers' drawings, repair manuals and other associated documentation, and these form the basis from which most queries and unexpected technical problems are resolved. Fortunately BBMF enjoys the support of British Aerospace (in particular the Weybridge and Kingston divisions), Rolls-Royce and many of the major firms which originally worked together to build these aircraft; therefore, defects or areas of concern which are felt to be beyond the Flight's capabilities are always referred to these organisations for advice or guidance. In turn, private owners and operators recognise the experience and expertise contained within BBMF and do not hesitate to seek its help, which is always readily given.

The engineering tasks on BBMF are carried out to various degrees of intensity during two distinct periods: these are October to March when the winter servicings take place and March to September when day-to-day maintenance and the rectification of unexpected defects are undertaken, to see the aircraft through the display season.

Reference to maintenance schedules dated March 1941 indicates that flying hour-based major servicings were car-

Below:
The Memorial Flight's hangar at RAF Coningsby. Each fighter has its own 'pen' on either side of the hangar. *Crown Copyright*







Top:
LF363 on winter overhaul at Coningsby. Both Hurricanes are at present powered by Merlin 502s, the civil version of the Merlin T24. *Crown Copyright*

Above:
PM631 being moved out for its first engine runs of the 1986 season. *Crown Copyright*

ried out on Hurricanes and Spitfires at a periodicity of 180 hours, providing of course that the machines survived that long. The current servicing cycle allows 360 hours or six years between majors, whichever occurs the soonest, with intermediate (primary star or minor) inspections being carried out every 60 hours or annually. It is the content of these inspections coupled with the rectification of associated defects which constitute the bulk of winter servicings. The extended periodicity of today's servicings reflect the comparatively gentle handling the aircraft receive — currently being restricted to a maximum speed of 275kt and loading of +3g, with any manoeuvres involving negative 'g' prohibited and flying through rain being avoided whenever possible.

The ever-decreasing number of spare parts available to keep the aircraft airworthy is an area which gives BBMF the greatest cause for concern. However, in some respects it has the advantage over most private operators. The Hurricanes and Spitfires positioned at some Royal Air Force stations as gate guardians are an obvious source of supply, although not as great as might be supposed because in the majority of cases these machines have been left to the mercy of the elements and allowed to deteriorate to such a condition as to make their component parts totally unusable when being considered for use in flying examples of the same type.

Donations from the general public provide a surprisingly high proportion of the Flight spares and have ranged from the odd switch or plug which had been a prized possession of a young enthusiast, to complete superchargers found hidden in sheds and garages. Without exception they are given with a desire to do something which will enable the historic aircraft to continue flying. In 1984 the Flight received a visit from a retired mechanic who, in 1945, had retrieved four Spitfire tail-wheels from a scrap yard with the intention of building a garden barrow. He never did get his barrow made and felt that perhaps BBMF could make better use of them instead. Such donations are always gratefully received. Service aircraft in current use are constantly monitored to identify spare parts which are compatible and, most importantly, readily available from military supply sources. As examples, the brake linings used on the Devon or Dove have proved to be completely suitable for use on the Spitfire Mk XIX, and Hunter pneumatic filters are equally at home in the Hurricanes.

When manufacturers' drawings or patterns and material specifications are available, parts can often be manufactured by tradesmen employed in Service workshops; general fitters working both at Coningsby and St Athan regularly produce items, sometimes at very short notice, which enable BBMF's aircraft to meet their display commitments. As a last resort spares are either purchased from, or manufactured by, specialist dealers, but this is done very reluctantly, because tight financial restraint allows for little expenditure of this type.

At times major repair and reconditioning programmes have been carried out on the fighter aircraft of BBMF to enable them to keep flying. In August 1978 Spitfire Vb AB910 was tasked to display at Bex Airfield in Switzerland. On the Spitfire's take-off run prior to the return transit flight a series of errors by the pilot, the local air traffic controller and pilot of a Harvard aircraft, who failed to obtain clearance to enter the active runway, resulted in a head-on collision. The Harvard was pushed back 50yd and completely

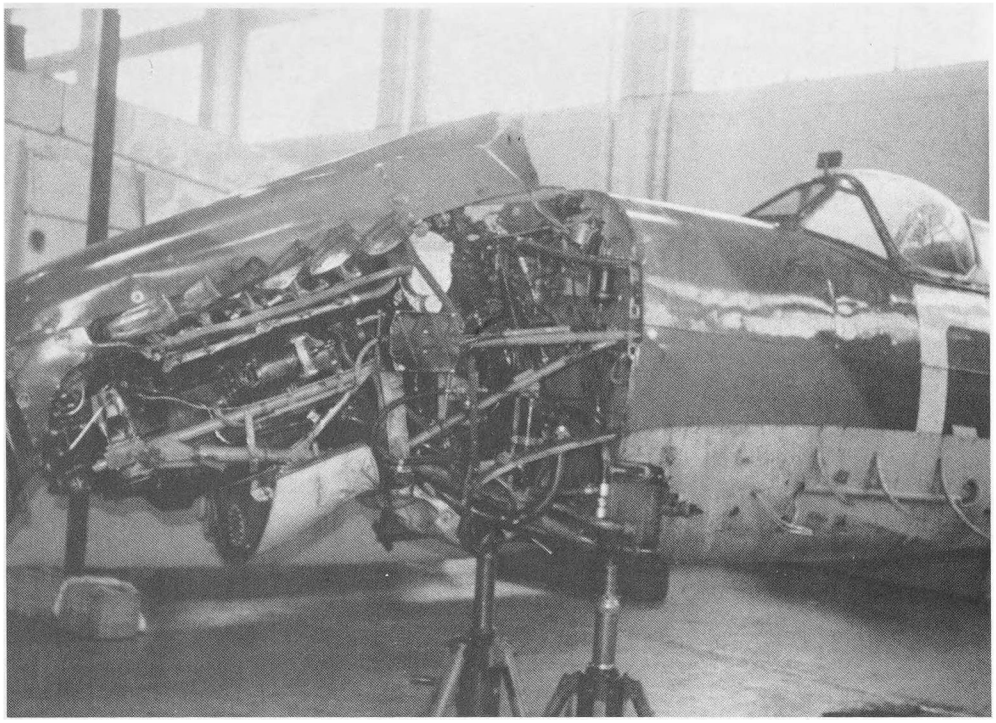


The 'office' of the Spitfire.
Richard Winslade

destroyed, while AB910 was damaged extensively. Surprisingly neither aircraft caught fire, and the Spitfire pilot and Harvard rear seat passenger quickly vacated their aircraft without injury; the Havard pilot broke his leg jumping from his machine.

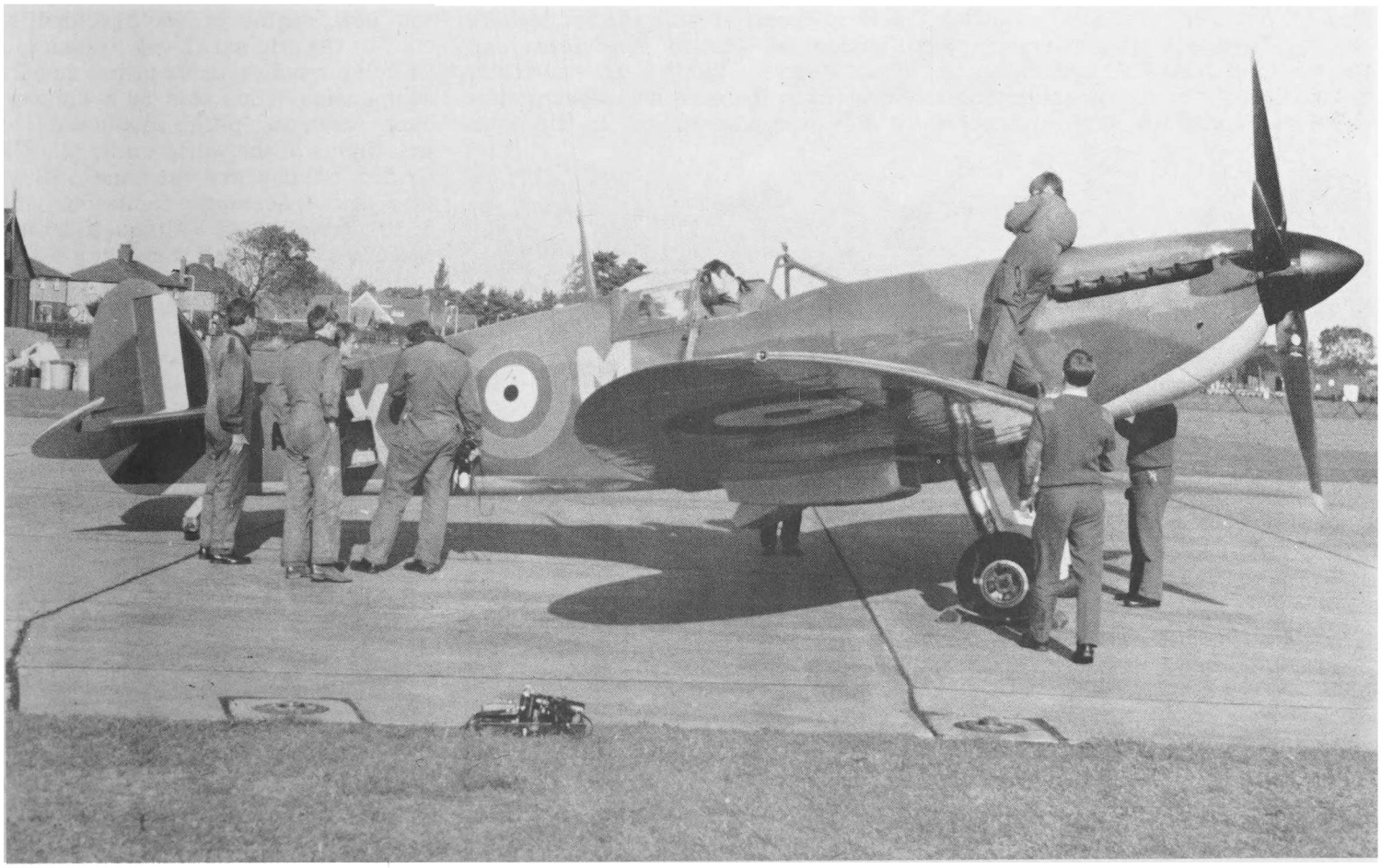
The Spitfire was virtually beyond economical repair and most likely was only recovered because it was a valuable historic aircraft. It had sustained damage to the engine, engine mountings, front bulkhead and both mainplanes, with extensive rear fuselage skin buckling. It was transported by road to Abingdon where over the next 18 months repair teams of the Repair and Salvage Squadron restored it structurally back to flying condition. A major servicing at Kemble followed before AB910 finally flew home to Coningsby and the BBMF in October 1981.

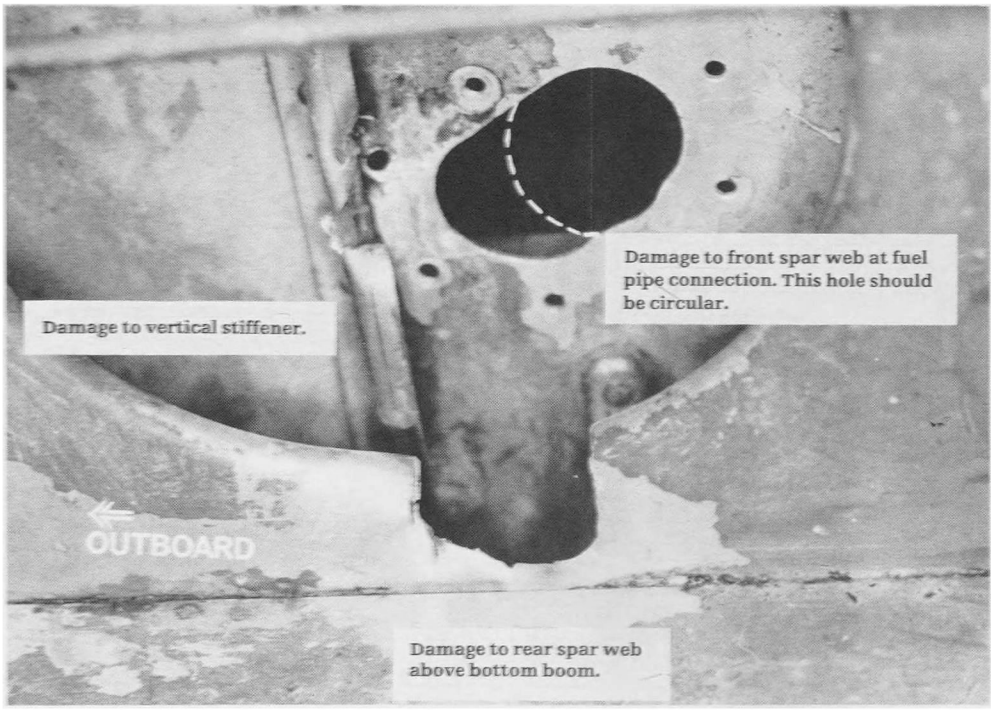
The inspection of Spitfire IIA P7350 carried out during the winter servicing period of 1983/84, and subsequent rectification of minor defects, fortunately brought to the notice of the engineers, some severe and malicious damage to the centre section spar webs. According to the repair manuals the damage was far outside repairable limits and therefore effectively grounded this fine old machine, the oldest on the Flight and a firm favourite of the ground crew, it having actually fought in the Battle of Britain during 1940. P7350 had been a gate guardian at Colerne and had been refurbished to flying condition for use during the making of the film *The Battle of Britain*. Perhaps while changing the installed Merlin XII engine for a reconditioned Merlin 35, the spar webs were hacked about to accommodate the main fuel feed pipelines. A suggested repair scheme was devised by BBMF and



Above:
The damage caused to AB910 in the accident at Bex in Switzerland.

Below:
AB910 is welcomed back to the Flight following repairs at Abingdon and Kemble.
J. and D. Marshal





Above:
An example of damage caused by enthusiastic amateurs. This 'work' was discovered during deep servicing to P7350 in November 1983 and was done at some time before the aircraft joined the Flight. *Crown Copyright*

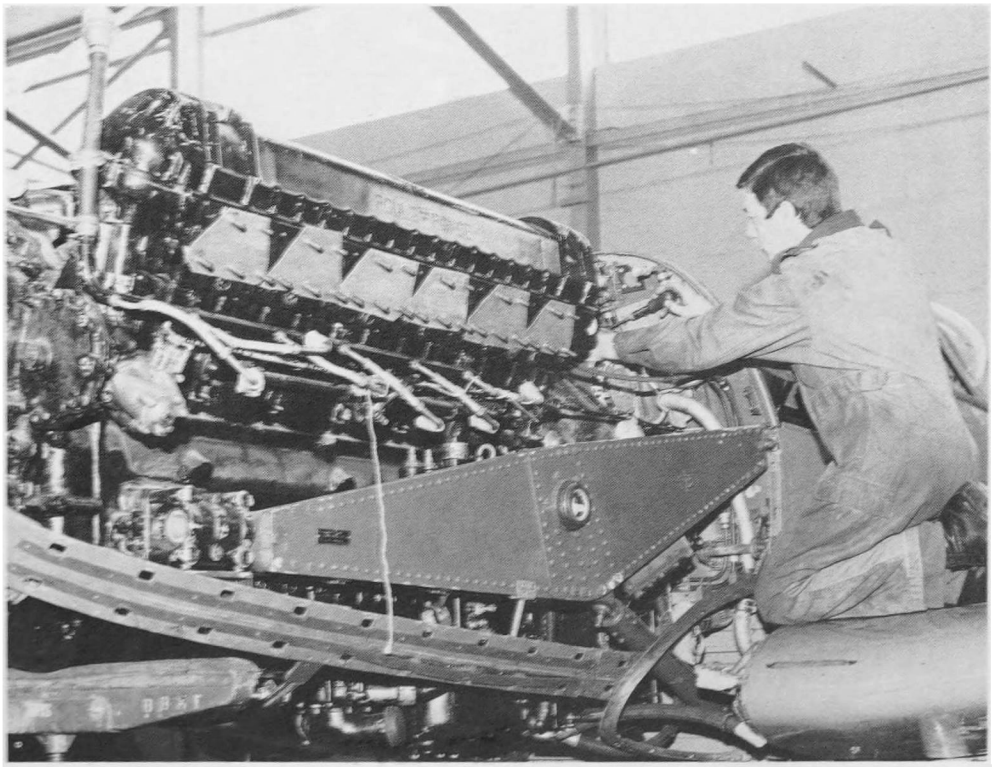
Below:
Installing the modified Griffon 58 in PS853 *Crown Copyright*

forwarded to the stress section at British Aerospace, Weybridge for consideration. It was approved with a few minor alterations and its implementation allowed the most beautiful aircraft on the Flight to continue gracing the skies at air displays around the country. This incident indicates how easily a moment's thoughtlessness could endanger these irreplaceable aircraft and explains why they are maintained to the modern standards and procedures as demanded by the Royal Air Force engineering authorities.

In co-operation with the Samlesbury division of British Aerospace and Rolls-Royce, BBMF is currently involved in the most ambitious project it has ever undertaken. It had been recognised as far back as 1974 that the future of Mk XIX Spitfires was bleak unless a replacement engine for the Griffon 61 or 66 could be found. BBMF had been investigating the possibility of converting a Griffon 58 as used to power the Avro Shackleton maritime reconnaissance aircraft, and determined that re-engineering would be necessary in several areas. The most significant of these concerned the twin reduction gearing situated at the front of the engine which was used to drive the Shackleton's contra-rotating propellers. The Spitfire XIX has only one propeller and consequently uses a single reduction gearbox. In addition, the Mk 58 supercharger casing was found to be 3/4in wider than the Mk 66 and fouled the port engine bearer of the powerplant frame. Further major problems were highlighted in no less than 22 separate areas.

The Derby engine division of Rolls-Royce undertook investigation into the possibility of removing metal from the supercharger casing and manufacturing single-shaft reduction gearboxes. A report published in 1978 indicated that the suggested modifications were feasible, but it was 1982 before the gearboxes and associated modification drawings were available. The redesign and manufacture of engine controls, cowlings, pipelines and so on had been an on-going, albeit slowly progressing, task. As previously mentioned, the lack of original spare parts is an area of considerably worry, so while adapting the new engine it was decided to convert the original 12-volt system to a 24-volt one which would utilise modern components. Thus this 50th anniversary year of the Spitfire should see the first flights of the world's only Mk XIX Griffon 58 powered machines, PS915 from British Aerospace Samlesbury and PS853 from BBMF. Although hybrid machines, they will remain aesthetically sound and perhaps go a long way towards ensuring the presence of airworthy aircraft to celebrate the Spitfire centenary in the year 2036!

Generally, Hurricanes LF363 and PZ865 are in remarkably good condition, and when considering these machines alongside the Spitfires, the future of the Battle of Britain Memorial Flight looks decidedly rosy, providing that the support of the various controlling bodies is maintained, and assistance from industry and the general public continues. This being the case, the Flight engineers will strive to keep the aircraft in the air for many years to come so that future generations may have the opportunity to see these beautiful flying machines in their natural environment and, at the same time, enjoy the magical music of Rolls-Royce Merlins and Griffons in full song.



Displaying the Heritage

The Pilot's Story

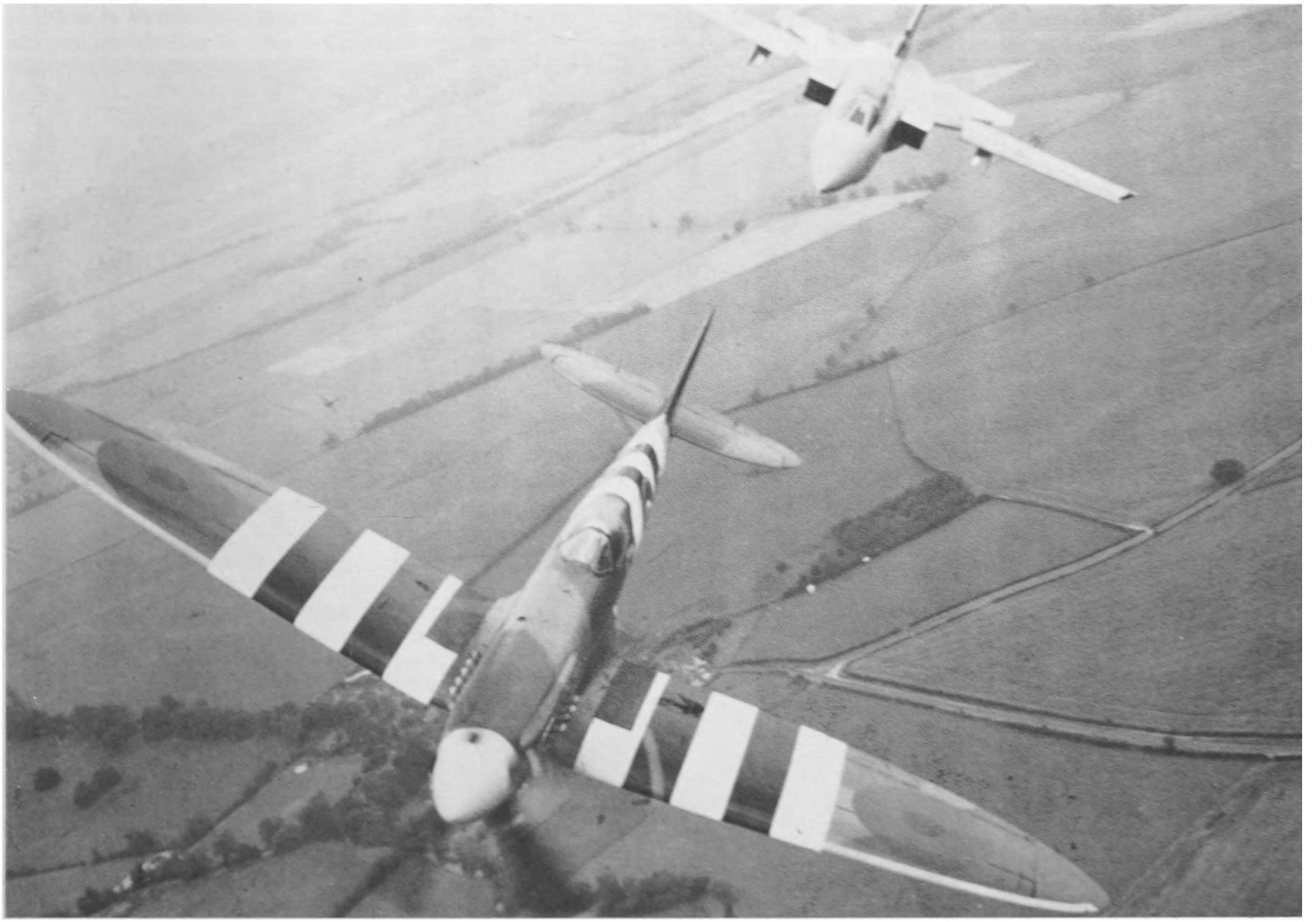
The BMMF display season typically runs from late April to mid-September, during the course of which our aircraft will appear at between 140-150 different venues, performing well in excess of 350 individual displays. To resolve a programme of this complexity, planning begins as early as September of the previous year, by which time most of the bids for appearance should have been received by the Participation Committee at MoD (Air), Whitehall. In December, representatives of all the display teams converge at MoD for an initial planning conference where the rough format of the next season is hammered into shape; another meeting in January completes the jigsaw, leaving only the fine-tuning of cancellations and late bids to be fitted in during the opening stages of the season.

Would that it were that easy! Bids always far out-weigh available resources, so compromise becomes the order of the day. As an approximation, BBMF is permitted to fly 75 hours on the Lancaster, 90 hours total on its two Hurricanes and 140 hours total on its complement of Spitfires. The allowances do not change in the face of long-term unavailabilities, which in time can generate immense engineering penalties if available aircraft are operated at a higher-than-planned rate. And nor are the above hours the final answer; the Training Officer deducts what will be required for airtests, initial conversion and type conversion, which typically removes about 7% of the available hours.

Next there are those events at which appearance is mandatory, such as all the RAF Battle of Britain displays, plus whatever high-visibility PR tasks may be dictated by higher authority, such as the Normandy invasion anniversary celebrations in 1984 and the Operation 'Manna' flypasts in Holland in 1985. One down from these are those major events such as the Biggin Hill air fair, Mildenhall and Fairford at which it is right and proper that we should appear as the cornerstone of the historic aircraft scene. After that, the rest is a simple matter of getting several gallons out of a pint thimble. We are assisted in our primary choices by an MoD public relations grading system which allocates relative importance to all bids received, and points us in the right direction. Typically this will produce a weekend format during which we have three primary displays to attend; without recourse to a map it will be evident that geographical locations indicate a further three minor venues which may be included en route, and a little deeper study will perhaps indicate another two locations where a flypast may be accomplished either by all three aircraft, or by the expedient of detaching a

Below:

Show-stopper of the 1985 season was the synchro display of the Spitfire and Tornado F2. The Memorial Flight shares its Lincolnshire base with No 229 Operational Conversion Unit, the first unit to receive the F2. Flown by Sqn Ldr Paul Day (Spitfire) and Wg Cdr Rick Peacock-Edwards (F2), the aircraft were photographed by Richard Winslade from the Lancaster rear turret.



single aircraft which later rejoins the main formation. The variations are almost infinite, but I hope this account will serve as an explanation of why, in an attempt to get maximum utilisation, BBMF occasionally has to tinker with display times up to a late stage, to the apparent dismay of organisers.

BBMF's primary objective is to maintain the historic aircraft in flying condition as a memorial to those who gave their lives in them; the secondary objective is to present these same aircraft, in their natural environment, to the public at large. These two objectives are frequently incompatible and give rise to properly imposed rules and limits which often prevent our appearance and are worthy of explanation, because they are sometimes misunderstood. In terms of weather limits we require a cloud base not lower than 1,500ft and visibility not less than 5km and undertake no operations in winds greater than 25kt; a crosswind component of 15kt maximum for take-off, 10kt component crosswind for landing, or in precipitation. Whilst it is impossible to describe aviation as a nil-risk business, the limits may still seem stringent, until the explanation is understood. The Lancaster apart, BBMF fighters are all crewed by pilots whose primary duty and background is in high-performance jet fighters, either the F-4 Phantom or the Tornado F2. Some may indeed have had piston tail-dragger experience back in the mists of time, but generally rely on what Chipmunk time is available out of season, plus the minimum safe work-up time that can be made available on the Spitfires or Hurricanes without cutting too deeply into the season's display hours. Against this background, and given that even 'real' Spitfire pilots concede the aircraft to be a bit of a handful in a crosswind, the landing and take-off limits are a realistic appraisal of our professional limitations. All BBMF fighters are as original in terms of instrument fit (ie wind-powered) as is the navigation fit (ie stopwatch, map and wandering compass). Given that we are often tasked to put a single fighter over a memorial service in an orchard in Kent on time (for example), 5km visibility seems a reasonable limit to impose on someone whose primary instinct is to ask the navigator — and failing a response to ask the Inertial Navigation System! The 'no precipitation' rule is a little more straightforward and relates primarily to propeller and airframe damage. All our fighters sport the original wooden propellers, which will suffer damage at prop speeds in excess of 2,000rpm even in moderate precipitation. The increasing scarcity of these items, combined with the rocketing repair costs and times, will get you famous very quickly for an infringement of this rule. If 'caught out' by rain whilst airborne, reducing prop-speed below 2,000rpm will limit damage, but the reduction of an already-mediocre forward visibility plus the near-certainty of minor damage to paintwork and canvas surfaces makes rain an element to avoid whenever possible.

The cloudbase limit of 1,500ft may seem somewhat more liberal than the others but is in fact a product of the form our displays take, which in turn is primarily dictated by the objective of preserving the aircraft rather than performing them to the limits of their capabilities. To this end the Spitfires and Hurricanes operate to the following constraints during display — 275kt max IAS, +3g (no negative, because of the primitive fuel systems and fatique consumption), 100ft min, max boost +6 for Merlins, +7 for Griffons. These limits, particularly in terms of permissible g and boost, preclude a fully developed display in the vertical (loops, vertical rolls, etc) and thus dictate a largely flat, turning display, conjoined

Below:
A splendid shot of Hurricane PZ865 *The Last of the Many*, taken by Arthur Gibson over Farnborough in 1980.



where appropriate with shallow wing-overs. Having, therefore, no requirements for extensive clear airspace in the vertical, a 1,500ft cloudbase fits the bill nicely, and is generally available on even a poor summer's day.

The last, but by no means the least, of a long list of the problems facing 'our' sort of aeroplanes during the season are those generated by the necessity of operations from the modern standard —NATO, single-runway airfield. By definition, single runways mean increasing risks of having to live with whatever crosswind prevails, and thus the risk of cancellation increases. Long single runways generally involve long taxi-patterns which are not to the taste of aircraft with fade-prone pneumatic brakes and a cooling system which was not designed for prolonged ground operations. Now add a hundred or so modern jet-powered participants which do not appreciate the problems of the historics, and the problems mount — the increasingly rare AVGAS bowser gets lost among the dozens of AVTUR vehicles; Air Traffic Control does not appreciate that for us to hold off for 10 minutes probably jeopardises at least three displays further down the line, but would have little or no effect on a jet participant; no, we can't taxi behind an F-15 with engines running, etc, etc, etc. The only solution to the 'big meet' problem is careful and thorough briefing, preferably face-to-face well before the event to ensure that all concerned understand fully just how different an animal a Spitfire or a Hurricane really is, and how easy it is to force a cancellation, having acted with the best of intentions.

But despite all the doom and gloom this account has suggested so far, we seem to manage with a less than 5% cancellation rate from season to season, the aircraft continuing to be major crowd-pullers as well as a source of constant delight to those who fly them. Much has been written by those much more versed than I in terms of displaying the Spitfire and Hurricane, so I will attempt briefly to cover the subject in broad terms, leavened with pertinent points from my own sometimes bitter experience. I will first address those factors which are common to all fighters, and end with some points specific to particular aircraft.

Planning

This exercise should always be complete by at least three days before undertaking what for the BBMF will normally be a series of displays. Mistake No 1 is to leave the navigation largely up to the Lancaster — only to find an unserviceable Lancaster come the day. I am sure nobody would be that remiss, but if the Lancaster does drop out, or the other fighter of a fighter pair, are they left with a route which they would rather not fly? Probably, and the answer is to plan as though one will always conduct the sortie solo, noting the relevant changes that would be necessary if things were better than expected. In the same spirit, only a fool would sit on the wing of the leader admiring the countryside; drop-outs on route are not unknown and should not bestow upon one an unprepared flight-lead status. To that end all pilots should be familiar with the execution of every aspect of the sortie.

Choice of route is dictated largely by the need to conserve hours and thus 'direct' is the preferred option. But, what are the penalties of finding a Pennine crossing unworkable; what if Heathrow doesn't come through with the expected clearance across the middle; and what will be the consequence of a poor radio on some of the above?

The Display Venue

Despite the problems which they generate, large air displays tend to be cut and dried in terms of obstacles, crowd line, deconfliction and such like, and require only that the pilot is happy that the factors pertinent to his particular problems have been taken care of, preferably by himself. ('Cheques in the post' syndrome!) The smaller events on the other hand can really bite, and are worthy of detailed attention. It may well be that by gentle persuasion the organiser may be swayed to re-orientate matters so that his spectators don't have to squint into sun to watch the aircraft, don't have to get the occasional glimpse through a line of poplars, or, as happened once, listen to a muted engine note in the distance. BMMF operates a Chipmunk, part of whose purpose is site surveys and whose timely use can prevent some nasty surprises at worst, or at least, some time-wasting unimpressive failures.

The Hurricanes

There are a number of cockpit design features of the Hurricane which would cause a flight safety officer to break into a cold sweat — not least the fuel system. Tank selection is manual and gauging is only available 'on demand'. There is no low level warning system, except on the overload tanks fitted to PZ865, whose operation is a subject in its own right. Consequently fuel planning is of major importance, particularly in terms of commencing a display with an appropriately full tank selected and, in the case of PZ865, of careful route planning to utilise the overloads only during periods of minimum distraction.

The brakes are pneumatic and give a fair warning of incipient fade; nonetheless, despite the reasonable forward view even on the ground, 'S' taxying is necessary, and so long distances need to be avoided, and steep inclines treated with great circumspection. The tailwheel breakout force is considerable, and can lead to embarrassment when attempting manoeuvres in a confined space at slow speed. As the radiator is in the propeller-wash, ground overheating is not the factor it is on the Spitfire, but can catch one out.

In the air the Hurricane is heavy in all axes, loses speed rapidly and is slow to regain it. It *will* go round a display like its counterpart, but requires extensive and constant use of elevator trim to lighten the load and extensive use of rudder in conjunction with aileron to produce a respectable rate of roll. It is thus vital that rolling manoeuvres are commenced with a respectably high nose-up attitude to counter the slow roll-rate and avoid excitement. From the above, it may be seen that a tight, point-display is not suited to the Hurricane and it is better to accept some slacking-off rather than to run out of ideas half-way through. The cockpit noise level at display power setting in the Hurricane has to be heard to be believed; the only safe solution is to throttle back in response to an R/T transmission and accept the consequences. Ease of landing under any given conditions accounts for why the Hurricane is the first-season aircraft for pilots joining BBMF.

Merlin Spitfires

BBMF currently owns Mk IIa P7350 and Mk Vb AB910, which are similar, differing only in that the Mk II has the external armoured-glass windscreen, which looks like an afterthought and does nothing for forward visibility when the murk sets in, and the interim elevator bob-weight which makes the stick heavy to hold back when not under load and requires an uncomfortable full nose-up trim setting in the landing configuration.

The Merlin Spitfire may be said to be blissfully at home once in the air, almost to the extent of no longer needing the pilot, save as someone to fulfil the reasonable demands for rudder compensation to counter g and changes of airspeed. It is light, responsive almost to a fault in terms of pitch control (remembering the 3g limit!) and has no vices that would be apparent under BBMF constraints. Fuel tank feed is automatic once switched on, though there is still no low-level fuel warning, and gauging is still 'on demand'. The fuel gauge shows bottom tank fuel only (37gal), and though I have found this feature embarrassing on a long range sortie in a Mk VIII, it is not a



Above:
The Lancaster and her faithful escorts en route from Warton to Brize Norton on 20 June 1985. The Spitfire was flown by Sqn Ldr Paul Day, the Hurricane by Wg Cdr John Ward, and the Lancaster by Sqn Ldr Scott Anderson.
British Aerospace

significant drawback to BBMF operations.

However, the Merlin Spitfire is as problematical on or near the ground as it is problem free once in the air. The brakes are pneumatic and will fade without warning — if in doubt, shut down and have it towed. It is very light in the tail and thus prone to nose over under harsh braking or taxying over rough ground. It is dreadfully gust responsive due to the low wing loading and large fin, and there's not much one can do about that. Crosswind landings are usually exciting because of the narrow-track landing-gear and the aircraft's unwillingness to stop flying. Swallowed pride and a wing-down, no-drift wheeled-on approach are the best solution. The aforesaid narrow track undercarriage not only makes taxying a maximum-concentration exercise, with a ground loop never far away for the devil-may-care, but also neatly blocks off the airflow to the split oil-cooler and radiator. Given a hot summer's day, a Merlin Spitfire will be in trouble from overheating it not airborne within six minutes of engine start. There is no forward visibility over the nose, so 'S' taxying is a must, with all the penalties that involves in terms of slow progress, fading brakes and over-heating engine.

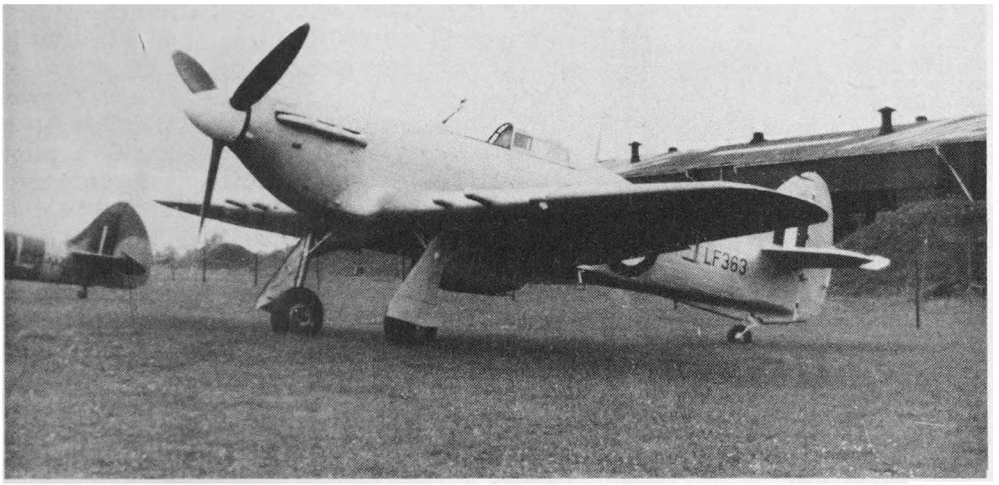
Griffon Spitfires

BBMF runs two Mk XIXs, PM631 and PS853, with another (PS915) due to join from a BAe rebuild during 1986. The Griffon is a left-hand tractor of some 2,000hp bestowing some 2½ft more nose in front of the pilot, thus increasing all the forward visibility problems inherent in the Merlin Spitfire, made somewhat worse by the addition of a curved windscreen which only permits 'true' vision through the centre 4in and can cause problems of apparent aspect on the famous curved-landing approach. The original Griffon 66, now only in PM631 (the others having been converted to the ex-Shackleton Mk 58), has the Coffman cartridge start which is complex and very sensitive to over-priming. Due to its much greater weight the Griffon Spitfire suffers the ground-handling and landing problems of the Merlin Spitfires to a much lesser degree, in as much as once it's on the ground it will tend to stay there, unlike its little sisters. The capacity of the coolant system is greater, as is the twin radiator area, and thus the Griffon is somewhat less prone than the Merlin to overheat.

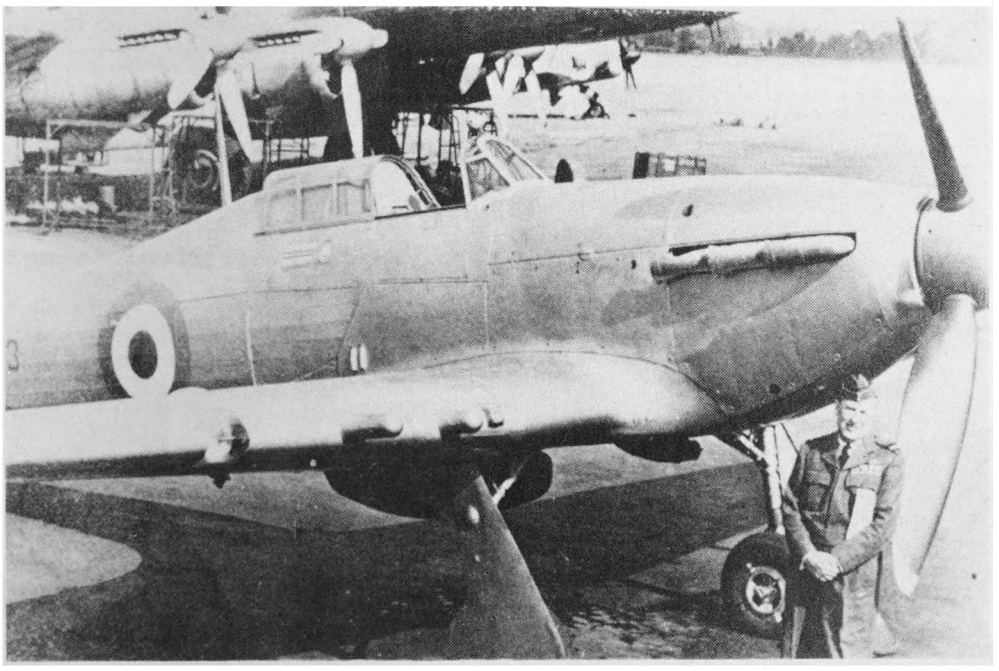
All that power tied to a five-blade propeller adds up to a lot of torque, which is the surprise to the first-time convert; indeed, a hard left turn which requires right rudder to balance it rather than the anticipated left rudder is the hallmark of the unfamiliar as he skids across the sky! Additionally, whereas the 'little' Spitfire and the Hurricane require only minor rudder inputs for changes in flight parameters, the Griffon is a constant game of football with the turn and slip gauge. No piston engine is particularly fond of rapid throttle demands, and this is particularly true of the 66 — a last minute demand for power on the approach will often result in little more than a disappointed sinking feeling. The radiator shutters of the Griffon are designed for automatic 'operation' based on temperature — unfortunately they have considerable aerodynamic effect and are best selected 'open' for displays to avoid nasty surprises at inappropriate times. However, in auto for cruise purposes they permit speeds as high as 240kt at power setting well within the limits and a good 60kt faster than the Merlin machines. Fuel capacity is 50% greater than the Merlin Spitfire, and the system incorporates automatic feed, a low-level warning light and constant gauging of the last 80gal. Though not as agile as the Merlin Spitfires, the Griffon-powered XIXs offer the flexibility of high speed and long range and consequently are frequently seen as solo items at long-distance venues.

In conclusion, the BBMF fighter display is not by any means a demonstration of what the fighters can do, but rather a presentation of the aircraft in sight and sound in a manner which must above all else be graceful and safe; graceful as befits particularly the lines of the Spitfire, and safe as befits two aircraft which are synonymous with the heritage of British military aviation and which are utterly irreplaceable. The problems not withstanding, our aim is to ensure the continued appearance of BBMF fighters in our skies well into the next century.

The Story of the Aircraft







Top:
One of the earliest known photographs of 'LF' — believed to be at Langley in 1949. *Pete Sargent*

Centre:
The most mysterious picture of 'LF', in Portuguese markings and fitted with 44gal drop tanks. The Flight has no information on this photograph. *Pete Sargent*

Above:
'LF' with Air Cdre Vincent (who as a Group Captain commanded Northolt from 14 January 1940) in September 1949 at Thorney Island.

Hurricane Mk IIc LF363

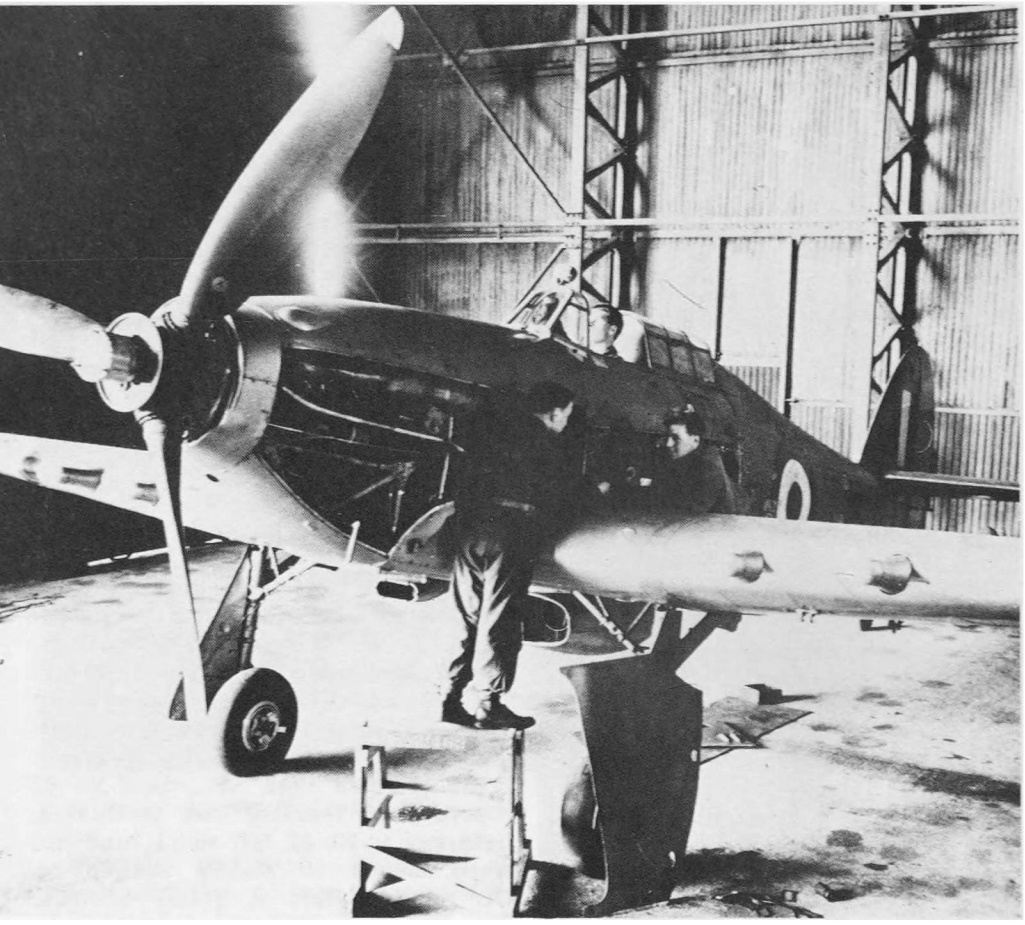
Although LF363 is the founder member of the Memorial Flight, it has the most incomplete history. Part of Contract L62305, it was built at Langley in late 1943 as a Mk IIc with bomb racks and a Merlin XX engine. It first flew on 1 January 1944 and was taken by a ferry pilot to No 5 MU Kemble on the 28th. Some two months later on 30 March 1944, it was ferried to No 63 Squadron at Turnhouse and then to No 309 (Polish) Squadron at Drem, Scotland on 23 May, where it was coded WC-H. Records show that between 1 November 1944 and 5 January 1945, 'LF' — as she is known on the Memorial Flight — was with No 22 MU Silloth, No 63 Squadron, No 26 Squadron and then No 22 MU again. It is more likely that it actually remained at No 22 MU throughout.

On 15 April 1945 'LF' joined No 62 Operational Training Unit at Ouston, returned to No 22 MU on 13 June and then moved to Middle Wallop on 28 August. Here it seems to have languished — on 21 June 1947 it was presumed Struck off Charge — but then appeared on 14 August 1947 on the strength of Fighter Command's Communication Squadron and on 19 February 1948 with the Station Flight at Thorney Island.

It is likely that 'LF' owes its survival to that move. In December 1947 the station had been transferred to Fighter Command and was part of No 11 Group, of which Air Cdre S. F. Vincent was the AOC. He had commanded RAF Northolt throughout the Battle of Britain and was determined that a Hurricane should remain airworthy to take part in displays and in the annual flypast over London.

At some time in late 1948, having taken part in the annual flypasts, 'LF' was taken to Langley, probably as the result of a mishap. It sat neglected there until Sgt Philip Carne, a fitter, was sent up from Thorney Island by Air Cdre Vincent to get it airworthy again. With the help of the Langley staff it was made ready by early summer 1949, but the pilot sent from Thorney Island to collect it had never flown a Hurricane before. Having flown it back to Thorney Island without a radio, he found that the wheels would not lower and, being unaware of the emergency 'kick-down' device fitted, he landed wheels up on the grass.

After much hard work and greatly encouraged by their AOC, personnel at Thorney Island had the aircraft ready in time for the 'At Home' days and London flypast of that September. On



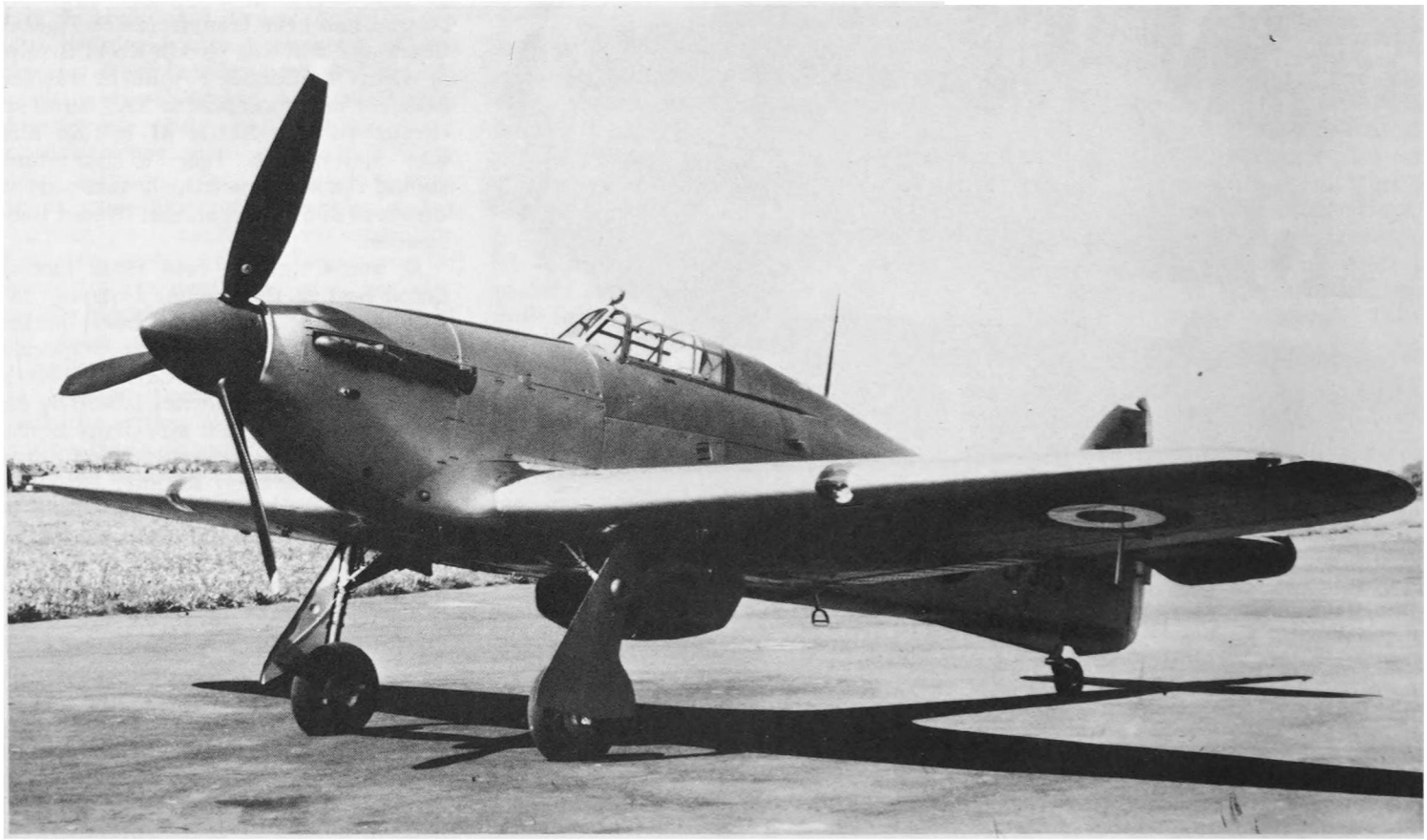
Above:
'LF' at Waterbeach in 1953 undergoing major servicing, with Sgt Gauge (on steps), AC Foster (in cockpit) and AC Fisher.

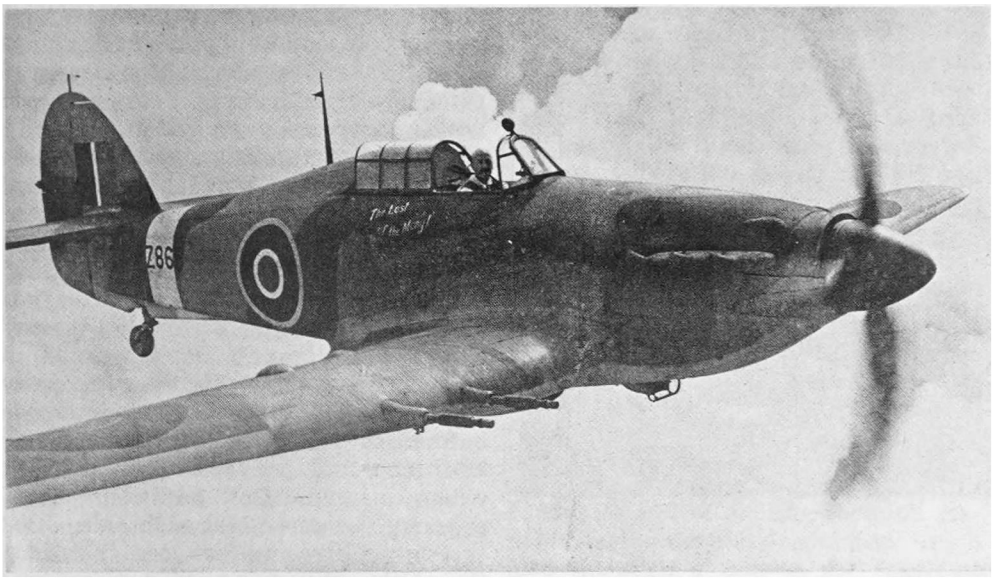
Below:
'LF' at Langley in 1956 after rebuilding, awaiting delivery to Biggin Hill. Note the loss of the cannon stubs.

15 May, when Thorney Island transferred to Flying Training Command, the station's resident fighter squadrons moved to Waterbeach and 'LF' went with them. Apart from brief spells at No 19 MU, with No 61 Group at Kenley and No 41 Squadron at Biggin Hill, it remained with Station Flight at Waterbeach. On 1 October 1953 it was assessed as Cat 3R after losing a canopy while being flown by a pilot from No 63 Squadron. A replacement was found at Hefton in March 1954.

On 30 September 1955 'LF' was sent to Hawker at Langley for a major overhaul. It emerged nine months later looking 'as new' in a silver finish, with the cannon removed and the wing leading edges re-skinned. It was collected by Wg Cdr Peter Thompson DFC on 28 June 1956 and flown to Biggin Hill, from where it took part in the Battle of Britain flypast that year.

On 11 July 1957 'LF' was joined by the three Mk XIXs and so the Memorial Flight was born. As the founder-member 'LF' has been with the Flight ever since, moving to North Weald, Martlesham Heath, Horsham St Faith, Coltishall and finally Coningsby. Over the years 'LF' has taken part in several films, including *Angels One Five*, *Reach for the Sky* and *The One That Got Away*. On 19 September 1965 she led a Spitfire over Bladon cemetery in a final salute to Sir Winston Churchill and in 1967 flew over Bentley Priory in the ceremony that marked the end of Fighter Command. In 1968 'LF' was used in filming *The Battle of Britain*.







Top:
'PZ' on an early flight with George Bulman, before the cannon had been removed.
Crown Copyright

Above:
Even in her racing days, 'PZ's' slogan remained.

Below:
PZ865 wearing number 41 when flown in the Kings Cup Air Race at Wolverhampton in 1950. The pilot, Gp Capt Peter Townsend, finished second.

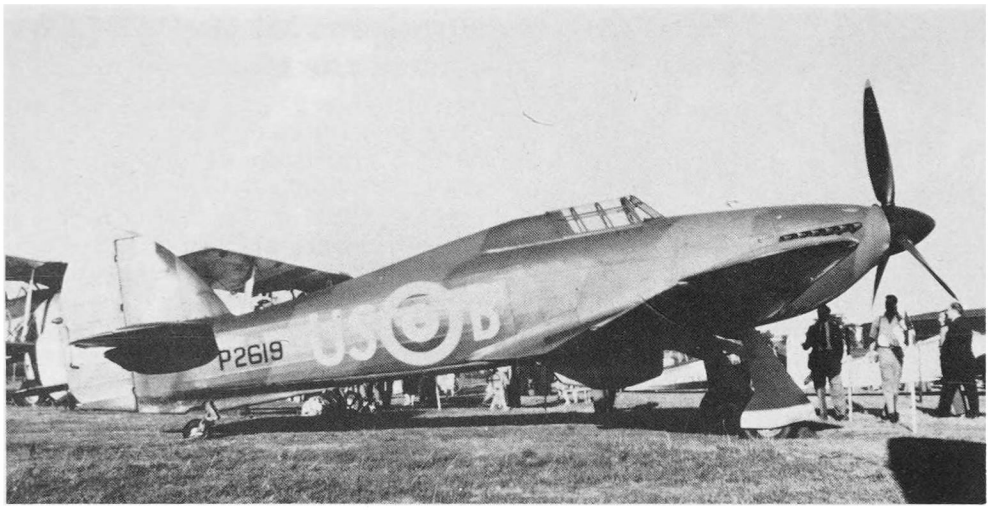
Hurricane Mk IIc PZ865 *The Last of the Many*

Completed on 27 July 1944 at Langley, Buckinghamshire on the same contract as LF363, Hurricane PZ865 was the last of 14,223 Hurricanes to be built. During construction a notice *The Last of the Many* was hung above it and was also painted on the fuselage beneath the cockpit. At the roll-out a special ceremony was held with PZ865 flanked by her predecessor, the Hawker Hart and successor, the Hawker Tempest. She was test-flown by George Bulman, the test pilot who had flown the prototype Hurricane on its initial flight on 6 November 1935. He gave a demonstration later that day to commemorate the end of the Hurricane production line. Immediately after construction Hawker bought PZ865 from the Ministry of Aircraft Production and it was used for test and communication purposes.

After the war PZ865 was placed on the civil register as G-AMAU. Painted royal blue and gold, it was often seen in air displays and races and in the 1950 Kings Cup race finished second, having been entered by HRH Princess Margaret. In 1951 PZ865 reverted to wartime camouflage again to feature in the film *Angels One Five*, afterwards returning to the civilian role of air displays and racing. During 1960 PZ865 was restored to the original camouflage scheme but the civilian registration was still retained and at one time both civil and military registrations were carried.

In the 1960s the aircraft was used at Dunsfold as a chase plane in target-towing trials for the Sea Fury and in the initial trials with the Hawker P1127 — forerunner of the Harrier. Its 70kt approach speed made it ideal for this. It also appeared in the film *The Battle of Britain* in 1968 and was re-covered with new canvas in 1969. It was then displayed at the Hawker Museum until





Above:
PZ865 in disguise as US-B for the film *Angels One Five*.

Below:
'PZ' over Brooklands/BAe Weybridge in November 1985 on the occasion of the 50th anniversary of the Hurricane's first flight. *The Last of the Many*, flown by Wg Cdr John Ward, was landed at Brooklands specially for the event. *British Aerospace*

1971, when reconditioning to flying condition took place. The company presented 'PZ' to the Memorial Flight at Coltishall on 30 March 1972 and it has since appeared in various squadron codes. However, as a tribute to those who built the Hurricane and to mark the 50th year, 'PZ' was painted in the factory camouflage of the time and carries the slogan *The Last of the Many*, an exact replica of the slogan painted on when it was built.

The slogan was originally painted on 'PZ' in preparation for the roll-out ceremony in 1944. It was Hawker's response to the 1942 film about R. J. Mitchell, the Schneider Trophy racing seaplanes and the Spitfire, which was called *The First of the Few*. In 1981 two brothers from Bromley in Kent, Bill and Tom Dean, found a rolled-up scrap of canvas in a dustbin at the back of the Imperial War Museum. It was clearly a piece of aircraft canvas, being painted with a matt sea-green and grey finish, and on it were the words *The Last of the Many*. How this canvas came to be there is a mystery, since 'PZ' had been repainted several times in the late 1940s and 1950s. However, this scrap is now mounted and framed in the Flight's collection of artefacts and memorabilia.

Although 'PZ' was built with four 20mm cannon, these were removed before its racing career began and additional fuel tanks were built into the wings instead. This additional fuel capacity — some 12gal each side — is the only difference between 'PZ' and 'LF'. Although it has carried no squadron codes for the last few display seasons, 'PZ' does wear the 18in pale-green fuselage tail band that was applied to all RAF fighters from November 1940.

On 6 November 1985, flown by Wg Cdr J. A. Ward, 'PZ' returned home to Brooklands, birthplace of the Hurricane, where she was the centre-piece of a major function organised by British Aerospace, Weybridge. It marked the 50th anniversary of the first flight from there of the Hurricane prototype in 1935 and the old airfield was opened again specially for the occasion.



Spitfire Mk IIa P7530

Originally ordered on 12 April 1938, against Contract No 981687/39, P7350 was the 14th production Spitfire of 11,939 built at the Castle Bromwich Aircraft Factory of Vickers Armstrongs (Aircraft) Ltd. It first flew in the uncertain days of early August 1940, with a Merlin III engine. It was delivered initially to No 6 Maintenance Unit at Brize Norton on 18 August, and thence to No 266 (Rhodesia) Squadron at Wittering on 6 September 1940, where it was coded UO-T. During its short stay with No 266 Squadron it flew a total of eight uneventful patrols. On 16 October it was one of 14 Mk IIs delivered to No 603 (City of Edinburgh) Squadron at Hornchurch — No 603 was an Auxiliary Air Force unit, its aircraft carrying the code letters XT-. The only recorded operational sortie with No 603 Squadron — a defensive patrol — was flown on 17 October by Flg Off Pinkney. On 31 October P7350 was damaged in an accident and sent to No 1 Civilian Repair Unit at Cowley, Oxford. Repairs were completed by 15 November and the next home for P7350 was No 37 Maintenance Unit at Burtonwood where it was stored until 18 March 1941. Next it was transferred to No 616 (County of South Yorkshire) Squadron, Royal Auxiliary Air Force at Tangmere. Its new code was YQ, which it wore only briefly because a further transfer took place on 10 April, to No 64 Squadron at Hornchurch, where it was coded SH. In May the squadron moved to Turnhouse.

Operational life ended on 5 August when it was sent to Scottish Aviation Ltd at Prestwick for overhaul and repair. This work was completed on 24 January 1942 and five days later it was once again sent to No 37 MU for storage. On 27 April 1942 it was issued to the Central Gunnery School at Sutton Bridge, where it served until a further accident, on 4 February 1943, necessitated transfer to Air Service Training Ltd at Hamble for repair. When complete, on 20 March, a short spell at No 6 MU, Brize Norton, was followed by service with No 57 Operational Training Unit from 31 March. Yet another accident, on 22 April 1944, caused a further visit to Air Service Training Ltd for repair. Completed on 13 July, it was taken on 24 July to the storage unit at Colerne (No 39 MU) which became P7350's home for the rest of the war. On 8 July 1948 it was sold for £25, as one of a batch of scrapped aircraft, to Messrs John Dale Ltd, metal dealers. Luckily the historic importance of the aircraft was recognised when the logbooks were examined and the company presented the aircraft to RAF Colerne, where it formed part of the stations's early aircraft museum. At that time it was fitted with a Merlin XII, No 12313.

It might well have stayed in the Colerne museum but for the film *The Battle of Britain*. In the mid-1960s the country-wide search for suitable aircraft found that P7350 was in such good condition that it was taken to RAF Henlow, where it was refurbished and restored to flying condition by Simpson Aero Services and the RAF on behalf of Spitfire Productions Ltd. Rolls-Royce and Simpson Aero Services overhauled the engine at Elstree, and Dowty Rotol renovated the propeller at Henlow. It was flown to Duxford on 20 May 1968, some 24 years after it had last flown, by Flt Lt Nobby Armstrong, having been loaned to Spitfire Productions Ltd and registered as G-AWIJ. The summer of 1968 saw P7350 visiting location airfields during the film production, which also included a trip to the South of France because bad weather was holding up filming in the UK — it was flown by Flt Lt R. B. Lloyd from Duxford via Deauville, Nantes, Bordeaux and Montpelier. On 24 September 1968 an engine change was necessary because metal was found in the oil filters — it had been installed since 1944. A Merlin 35 from Jersey Aviation, No 204573/A.510174, was fitted at Duxford and the aircraft flew to Bovingdon to complete filming.

On completion of the film the aircraft was returned to the Royal Air Force and, on 6 November, flown from Bovingdon by Sqn Ldr Tim Mills to the Battle of Britain Memorial Flight at RAF Coltishall, with which it has remained ever since. In May 1969 it was repainted at No 5 MU Kemble and coded ZH-T. It appears in different paint schemes and code letters after each overhaul to commemorate the various squadrons of the Battle of Britain or other significant aspects of the war. It underwent its last major overhaul at Kemble between 23 September 1981 and 26 August 1982, rejoining the Flight as QV-B.

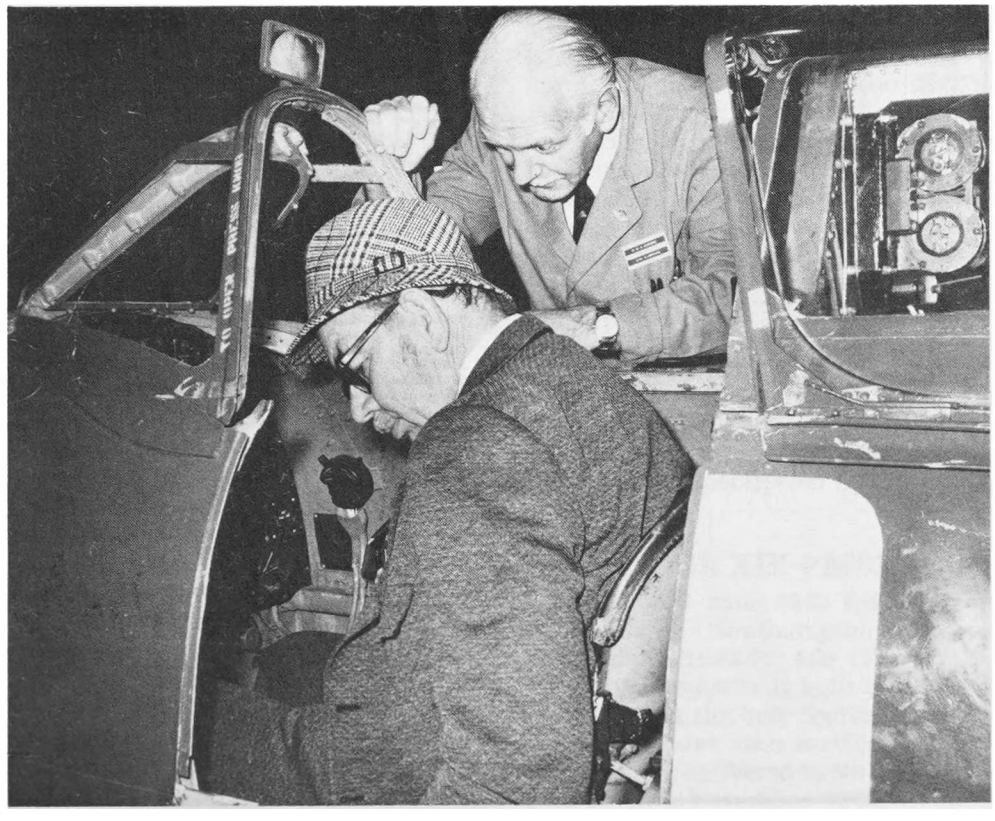
Spitfire Mk Vb AB910

Ordered as a Mk 1 against Contract No B981687/39 on 22 June 1940, AB910 was built in 1941 at the Castle Bromwich Aircraft Factory of Vickers Armstrongs (Aircraft) Ltd as a Mk V and first flew in August. It had a Merlin 45 engine and 'b' type wing and was delivered to No 6 MU at Brize Norton on 17 August 1941. It was then issued to No 222 (Natal) Squadron at North Weald on 22 August, coded ZD. After an accident only two weeks later, on 5 September 1941, it was taken to Air Service Training Ltd at Exeter for repairs, which were completed on 20 September, and 10 days later AB910 was flown to No 37 MU Burtonwood for store.

Some two months later, on 12 December 1941, it was issued to No 130 (Punjab) Squadron and coded PJ-, but on 15 January 1942 it was taken to Westland Aircraft Ltd for more repairs.

Below:

At Kemble, on 16 September 1976, ex-Flt Sgt 'Dixie' Alexander is shown over AB910 by one of the civilian technicians. On 19 August 1942, as an 'Eagle' pilot on No 133 Squadron, 'Dixie' shot down a Dornier 217 in AB910.



Although these were completed by 28 March, the aircraft was not flown to No 6 MU Brize Norton until 8 April. After a short period in store it was allocated to No 133 'Eagle' Squadron on 13 June 1942 and coded MX-E.

In August No 133 Squadron was operating from Lympne — a typical day was 19 August 1942, when the squadron was ordered to patrol the Dieppe area on Operation 'Jubilee'. AB910 flew four sorties that day, three of them by Flg Off Doorly. On his second patrol in AB910 he helped destroy two FW190s and one Ju88, while four more FW190s and three Do217s were damaged. Flt Sgt



Right:
Flt Sgt R. I. Alexander as an American volunteer in the RAF.

Below:
A copy of the Operations Record for No 133 Squadron on 19 August 1942. AB910 flew four missions in support of the abortive Dieppe raid. *Public Records Office, Kew*

DETAIL OF WORK CARRIED OUT

BY No. 133 (Eagle) Squadron. **SECRET** PAGE No.

FOR THE MONTH OF 19 August, 1942

29/1630. 180m. 8/40. P.I. 51-7751.

AIRCRAFT TYPE & NUMBER	CREW	DUTY	TIME UP	TIME DOWN	DETAILS OF SORTIE OR FLIGHT
Spitfire VB.					
EN.951	S/Lt. D.J. Blakeslee	Commando Escort	0720	0840	1st Patrol - Operation Jubilee
BL.523	P/O. D.E. Lambert	Cover			
EP.180	P/O. C.A. Cook				The Squadron took off at 0720 hours with orders to
W.3168	P/O. L.T. Ryerson				orbit Dieppe at 7,000 feet. Target reached without
BL.983	P/O. R.N. Beaty				incident but combats with enemy aircraft took place
BL.962	P/O. G.G. Neville				soon after. F/Lt. Blakeslee, D.F.C., P/O. Baker
EN.834	P/O. W.H. Baker				and F/Sgt. Alexander all had combats and between them
BL.773	F/S. R.L. Alexander				destroyed 2 FW.190's plus another probably destroyed.
AD.237	F/Lt. E.G. Brettell				Squadron suffered no casualties and all returned safely
EM.530	P/O. J.C. Nelson				to base at Lympne at 0840 hours.
AB.910	P/O. E. Doorly				
AA.973	P/O. G.B. Sperry				
EN.951	F/Lt. D.J. Blakeslee	Commando Escort	1015	1130	2nd Patrol - Operation Jubilee
BL.962	P/O. R.E. Smith	Top Cover			
EP.180	P/O. C.A. Cook				The Squadron were ordered up again at 1015 and ordered to
W.3168	P/O. L.T. Ryerson				fly as top cover over Dieppe at 12,000 feet. Many
BL.983	P/O. R.N. Beaty			1135	combats ensued immediately the target was reached and
BL.523	P/O. D.E. Lambert			1140	the following claims were made after these actions :
EN.834	P/O. W.H. Baker			1120	
BL.773	P/O. G.G. Wright			1130	DESTROYED :- 1 Ju.88 and 2 FW.190's
AD.237	F/Lt. E.G. Brettell				DAMAGED :- 4 FW.190's and 3 Do.217's
EM.530	P/O. D.S. Gentile				
AB.910	P/O. E. Doorly				Pilots responsible for these successes were :-
MX.K(U.S.Army)	P/O. D.D. Gudmundsen				F/Lt. Blakeslee, D.F.C. F/Lt. Brettell
					P/O. Beaty, P/O. Wright, P/O. Gentile, P/O. Baker
					P/O. Doorly and P/O. Gudmundsen
					Squadron casualties were again Nil. All returned and
					landed safely at by 1140 hours.
EN.951	F/Lt. Blakeslee	Commando Escort	1225	1345	3rd Patrol - Operation Jubilee.
P.8758	P/O. H.L. Ayres				
EP.180	P/O. C.A. Cook				The Squadron was ordered up again at 1225 hours with orders
W.3168	P/O. L.T. Ryerson				to orbit Dieppe. In the ensuing combats P/O. probably
BL.983	P/O. R.N. Beaty				destroyed a Do.217, F/Sgt. Alexander claimed a Do.217
BL.523	P/O. R.E. Smith				Destroyed and F/Lt. Blakeslee claimed a F.W.190 as Damaged.
EM.530	P/O. J.C. Nelson				At this period the evacuation of troops was observed to
AA.973	P/O. G.B. Sperry				be in full process. Large and small boats were being
AD.237	F/Lt. E.G. Brettell				dive-bombed by the enemy and 2 ships, one a destroyer,
EP.167	P/O. W.C. Slade				were seen to receive direct hits. All the Squadron
AB.910	F/Sgt. R.L. Alexander				aircraft returned safely to base at 1345 hours.
EN.834	P/O. R.E. Smith				
Spitfire VB.					
EN.951	F/Lt. D.J. Blakeslee	Commando Escort	1955	2055	4th Patrol - Operation, Jubilee
P.8758	Sgt. C.H. Robertson	Cover			
EP.180	P/O. C.A. Cook				The Squadron took off for the fourth and last patrol
W.3168	P/O. G.G. Neville				at 1955 and were ordered to patrol the convoys
BL.983	P/O. R.N. Beaty				returning from Dieppe. Convoys were now 10 miles S.E.
BL.523	P/O. D.E. Lambert				of Eastbourne. No enemy aircraft flew over the convoy
AB.910	P/O. E. Doorly				Nothing of importance took place and visibility had now
EN.834	P/O. W.H. Baker				deteriorated considerable. All our aircraft returned
EP.167	P/O. D.S. Gentile				and landed without further incident by 2055 hours.
EM.530	P/O. J.C. Nelson				
MX.K.	P/O. D.D. Gudmundsen				
AD.237	F/Lt. E.G. Brettell				

Flying Officer, Intelligence Officer,
No. 133 (Eagle) Squadron. R. A.F.

'Dixie' Alexander then flew AB910 on its third patrol of the day, during which he shot down a Do217 near Dieppe.

On 2 September 1942 AB910 was transferred to No 242 (Canadian) Squadron, with the code letters KV. Two months later, on 12 November, it was sent to No 12 MU Kirkbride for repairs before moving to No 33 MU Lyneham on 8 June 1943. The following month it joined No 416 (RCAF) Squadron, coded DT-, followed by transfer on 17 February 1944 to No 402 (RCAF) Squadron with code AE-.

AB910's operational life ended on 20 July 1944 when it was transferred to No 53 Operational Training Unit at Kirton-in-Lindsay, with code MV-T. The OTU used Hibaldstow as a relief landing ground; it was there that LACW Margaret Horton was taken for an unexpected ride. On 9 February 1945 the 'rough weather' order had been given, which required a mechanic to ride on the tail as aircraft taxied to and from the runway in the strong wind. The pilot of AB910, Flt Lt Cox, was unaware that the order had been given and therefore did not expect a 'tail rider'. He taxied out and took off without giving Margaret chance to jump off. Fortunately he decided that the aircraft was behaving abnormally and, encouraged by Air Traffic Control, flew a circuit and landed.

The next unit for AB910 was No 527 Squadron at Digby, where it arrived on 17 May 1945 coded WN-S. This was a radar calibration unit and on 18 April 1946 the aircraft was allocated to a similar unit at RAF Watton, Norfolk. Only six weeks were spent there before transfer to storage at No 29 MU, High Ercall on 30 May.

Many aircraft were sold for scrap during the next few years. AB910 was destined to be broken up but was spared this fate by the then Gp Capt

Allan Wheeler, who purchased it for £200. On 9 June 1946 he flew it from High Ercall to Beaulieu and then to Vickers at Swindon, where it was overhauled and civilianised, emerging in a metallic blue as G-AISU. It was registered as such on 25 October 1946. From Vickers, Allan Wheeler flew it to RAE Farnborough, where he commanded the Experimental Flying Department and where it was tuned for air racing.



Right:
Margaret Horton in RAF Association uniform at Coltishall in 1965, remembering her ride on AB910. She had earlier demonstrated the position she had been in, sitting on the right-hand tailplane and leaning across the fin.

Below:
The combat report filed by Flt Sgt 'Dixie' Alexander on 19 August 1942, after his successful combat sortie in AB910. *Public Records Office, Kew, Air 50/55*

SECRET

OPERATION " JUBILEE"

Substitute Form "F"

BIGGIN HILL SECTOR.

PERSONAL COMBAT REPORT

II N42/R16/83

(A) Sector Serial Number _____

(C) Date August 19th 1942

(D) Flight ____ Squadron 133 EAGLE

(E) Number of Enemy Aircraft Various

(F) Type of Enemy Aircraft FW. 190's & DO.217's

(G) Time Attack was Delivered Approx: 1315 hours

(H) Place Attack was Delivered In Dieppe area

(J) Height of Enemy 4000 ft - sea level

(K) Enemy Casualties 1 DO. 217 Destroyed

(L) Our Casualties - Aircraft NIL

(M) Our Casualties - Personnel NIL

(N) 1. Searchlights n/a

2. Anti-Aircraft n/a

(P) Range at which fire was opened in each attack & estimated length of burst 200 yards - various bursts totalling 15 sec:

Total number of rounds fired 65 cannon - 1250 m/g.

Pilot's Name F/SGT: R.L.ALEXANDER

GENERAL REPORT:

I was flying Yellow 3 in the third sortie. I saw Yellow 1 attack an FW. 190 who was flying at 12.000 ft. in a S.W. direction. The e/a broke away in a dive. I broke down after him & closed to 200 yards. I fired 2 bursts with cannon & m/g but did not observe any effects of my fire. The e/a was taking strong evasive action by jinking & turning, diving & climbing. I followed him down to about 3000 ft: He was then out of range so I pulled up. I then rejoined my section. We were immediately jumped by 2 FW. 190's from astern & from the port side. The section broke. I lost my No. 4 when I broke. I had been orbiting looking for my section for about 5 minutes, when I saw a number of DO. 217's approaching Dieppe from the North. I was then at 4500 ft. I closed on one of the Dorniers & fired several bursts of cannon & m/g from dead astern & closing to 200 yards. I saw smoke coming from his port engine & I did not experience any return fire. The e/a went into a shallow dive. I followed him. I could not fire as I had expended all my m/g ammunition & my cannon had a stoppage. I saw the e/a crash in a field about 5 miles South of Dieppe.

I claim 1 DO 217 Destroyed.

R.L. Alexander F/Sgt

Camera gun exposed.

R.L.Alexander - F/Sgt: U.S.A.

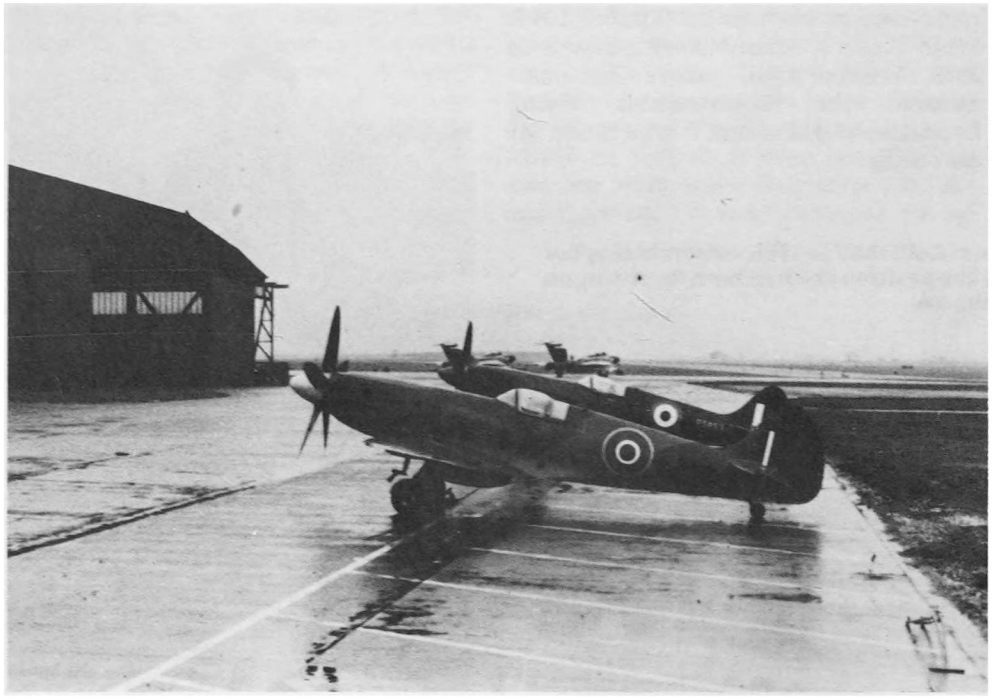
In addition to flying Royal Aero Club races at Elmdon and Kemsley in 1949 with Allan Wheeler, he also loaned it to Miss Becky Sharpe, an ex-ATA pilot who raced it in the Kings Cup Air Races — in 1950 she raced Peter Townsend who was flying Hurricane PZ865. At one of her races Becky Sharpe had a landing accident which resulted in AB910 being sent to Vickers Armstrongs Ltd for repairs. The company asked to buy the aircraft following this work and it was registered to the company on 19 May 1955. On 22 August 1955 it was restored to military markings and for the next few years was flown occasionally at charity air displays.

On 16 September 1965 AB910 was presented back to the Royal Air Force and the Memorial Flight at RAF Coltishall. During 1968 it was loaned to Spitfire Productions Ltd for the film *The Battle of Britain*, where it appeared in numerous squadron codes. But AB910's accident streak was not finished — on 20 August 1978 it was involved in a taxying accident during an airshow at Bex in Switzerland. It was recovered to Abingdon for a major rebuild and then to Kemble for a full servicing. It did not fly again until 27 October 1981, when it rejoined the Flight.

On 6 September 1985 AB910 was flown to Cranfield for overhaul and repainting, to emerge carrying the code BP-O and the inscription *In Memory of R. J. Mitchell.*

Spitfire Mk XIX PM631

Ordered on 2 June 1943 from Vickers Armstrong, Southampton, under contract Air/1877 for 600 LF Mk VIIIs, PM631 was eventually built in 1945 as a PR XIX. It is the only Spitfire with the BBMF not have seen service in World War 2, being delivered to No 6 MU Brize Norton on 6 November 1945, where it



Above:
PM631 in company with PS853 at Binbrook in January 1964. In the background are Javelins of No 64 Squadron.

was stored until moving to No 203 Advanced Flying School on 6 May 1949. This unit was renamed No 206 OCU on 12 January 1950 and the next day PM631 was flown back to No 6 MU. On 30 June 1950 it went to No 9 MU Cosford and, apart from three weeks at Buckeburg from 15 January 1951, stayed with No 9 MU until being assigned to the Met Flight at Hooton Park on 2 July 1951.

Two weeks later the Met Flight moved to Woodvale, where 'PM' remained until 1957. When the Met Flight re-equipped with Mosquitos, 'PM' was flown to Duxford on 14 June 1957 by Eric Richards, one of the Met Flight pilots, in company with PS915. Taken back into the Royal Air Force, 'PM' was then flown by Wg Cdr Peter Thompson to Biggin Hill on 11 July 1957, in formation with PS915 and PS853, for the formation of the Memorial Flight.

It has been with the Memorial Flight ever since, moving with the Flight to North Weald, Martlesham Heath, Horsham St Faith, Coltishall and finally to Coningsby in 1976. Much has been made in some books about combat trials of a Spitfire and Lightning from Binbrook. In fact, in January 1964 'PM' was flown to Binbrook by Flt Lt J. Armstrong, where he flew a sortie against a Javelin of No 64 Squadron. This was at the time of the Indonesian confrontation, when Javelins of No 60 Squadron in the Far East were used at Kuching and Labuan, and the trial with 'PM' allowed an assessment to be made on use of the Firestreak missile against piston-engined aircraft.

In 1968 'PM' was used in the filming of *The Battle of Britain*, again flown by Flt Lt Armstrong. On 5 March 1986 it was flown over Central London by Sq Ldr Paul Day to mark the 50th anniversary of the first flight of the Spitfire — making a nostalgic sound over the City that depended so much on the Spitfires of 1940.

Spitfire Mk XIX PS853

On 17 July 1943 a contract was placed with Vickers Armstrongs (Supermarine) for a batch of 200 HF Mk VIII Spitfires. The contract — Air/1877 — was changed several times because of the progress of the war, but 79 of this batch were completed as PR XIXs. PS853 was built at Southampton and delivered to the Central Photographic Reconnaissance Unit at Benson on 13 January 1945 for initial photographic preparation. After camera installation and testing it was delivered to No 16 Squadron at Melsbroek (B48). When the squadron was disbanded on 17 September 1945, PS853 joined No 268 Squadron at Celle but, on 20 October, No 268 was renumbered as No 16 Squadron.

With the war over, PS853 was sent to No 29 MU High Ercall on 18 March 1946 for store. Whilst there, in January 1949, it suffered Cat B damage and, on 9 March, was moved to Vickers for manufacturer's repairs. These were completed on 24 March 1950 and it was flown to No 6 MU, Brize Norton six days later.

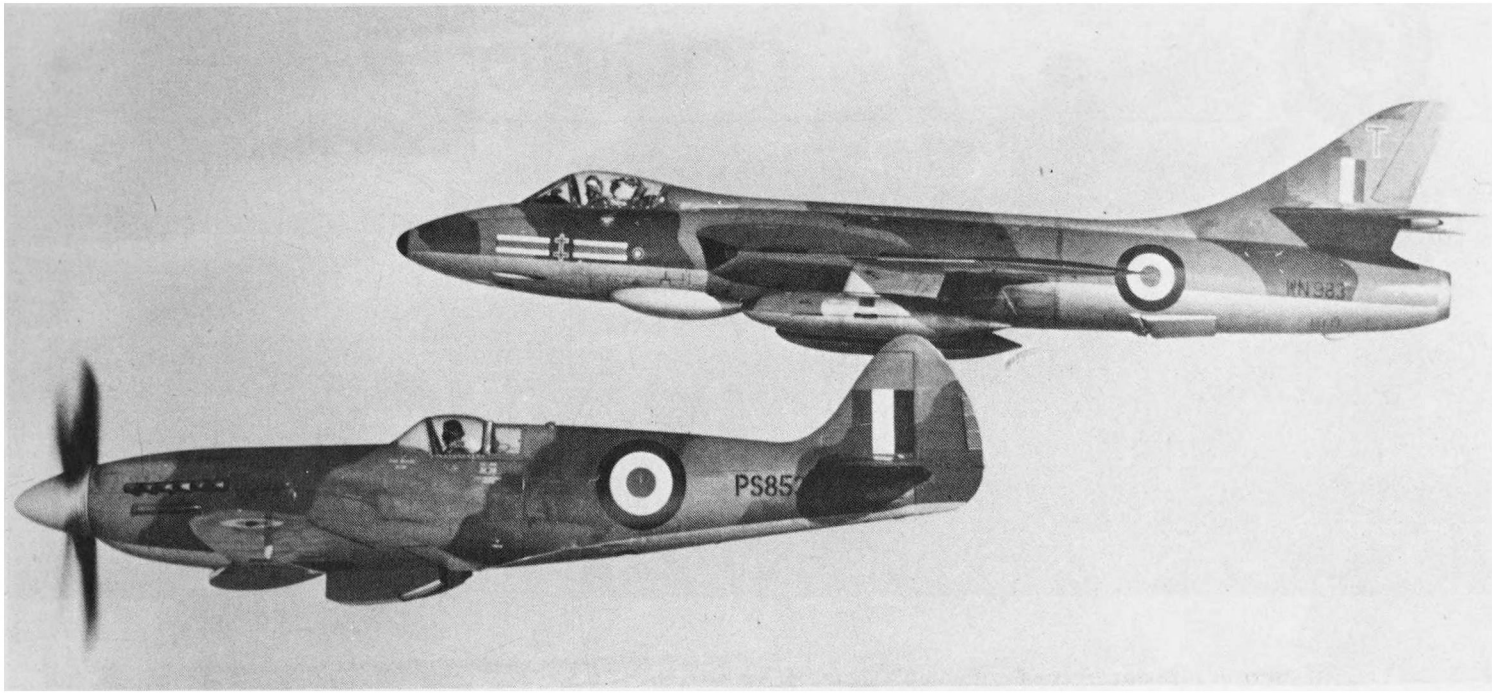
On 13 July 1950, PS853 was flown to No 9 MU, Cosford where it was modified and delivered to the Met Flight at Woodvale on 16 April 1952. It remained with the Met Flight until the latter re-equipped with the Mosquito in 1957.

On 26 June 1957 it was flown by John Formby, chief pilot on the Met Flight, to Duxford where it was returned to the Royal Air Force. Two weeks later, on 11 July, flown by Gp Capt J. E. 'Johnny' Johnson, PS853 led the formation of three Mk XIXs to Biggin Hill, escorted by three Hunters and three Javelins. At Biggin Hill the Spitfires joined the lone Hurricane and the Memorial Flight was formed.

PS853 moved with the Flight to North Weald on 1 March 1958 but on 14 April it was flown to West Raynham. It was then struck off charge as Cat 5 on 1 May

Below:
The first attempt by John Formby to take '853' to Duxford on 12 June 1957 ended like this, after an aborted take-off with an engine failure. The pilot ran out of runway.





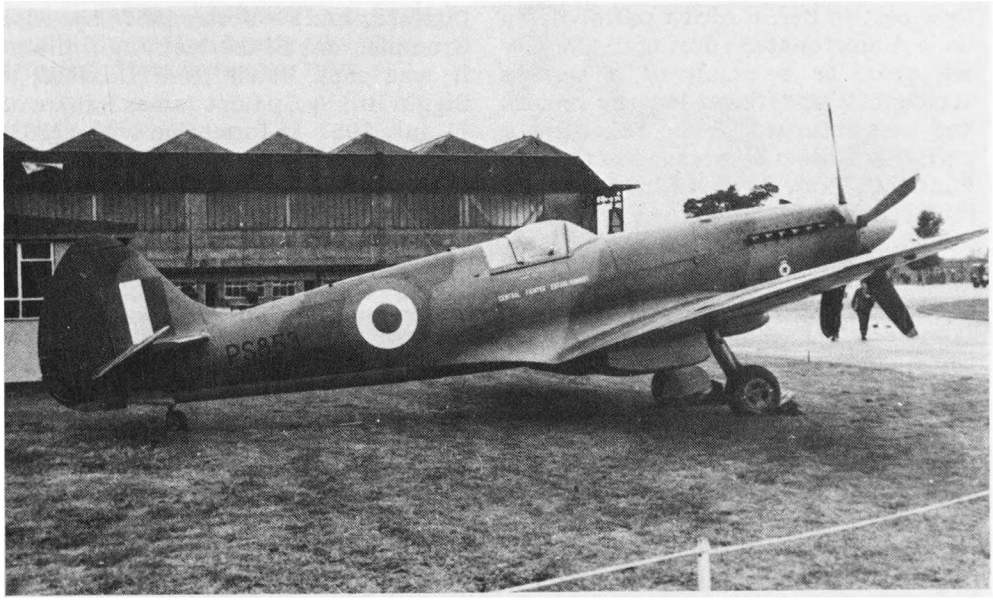
1958 and became a 'gate guardian' but, fortunately, was rescued in 1961 and restored to the strength of Central Fighter Establishment, West Raynham on 31 November 1962. It subsequently moved with the unit to Binbrook. PS853 was flown at Binbrook by Wg Cdr John Nicholls, CO of CFE, including various exercises which may have given rise to the impression of trials to assess the Lightning for Far East operations. On 16 April 1964 it was handed back to the Memorial Flight at RAF Coltishall and has remained with the Flight ever since. On 19 September 1965 PS853 followed the Flight's Hurricane over Bladon cemetery in a final salute at the interment of Sir Winston Churchill. In 1968 it was used in the filming of *The Battle of Britain* and in 1973 appeared in the PR blue finish used by the PR Spitfires in 1945. This finish was retained after its major overhaul at No 5 MU Kemble in 1981. PS853 is currently being modified internally to allow the fitting of a Griffon 58 in place of its original Griffon 66, spares for the latter being too difficult to obtain.

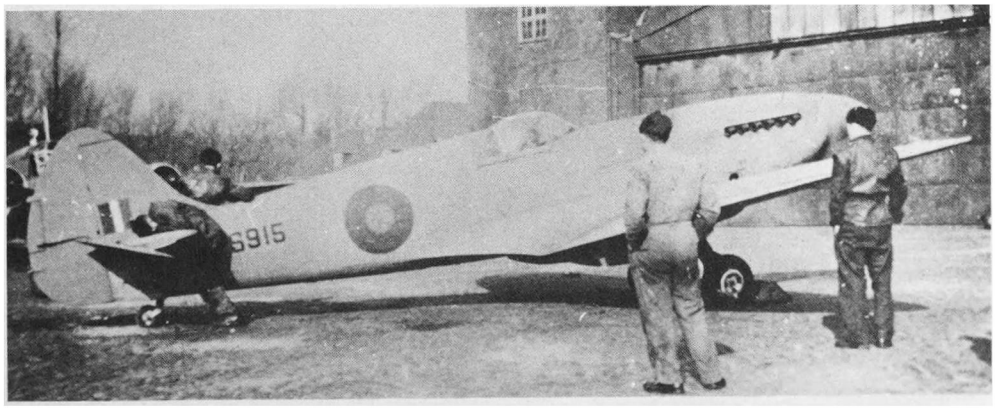
Spitfire Mk XIX PS915

As with PS853, PS915 was another of the batch of 200 HF Mk VIII Spitfires ordered from Vickers Armstrongs (Supermarine) on 17 July 1943, of which 79 were completed as Spitfire XIXs. It was built at the Southampton works and delivered to No 6MU at Brize Norton on 17 April 1945, being issued to the Central Photographic Reconnaissance Unit at Benson nine days later. It was allocated to No 541 Squadron on 21 June 1945, returning to Benson on 22 July 1946. On 10 October it was allocated to another PR unit, possibly No 151 PRU, until 8 July 1948 when it joined No 2 Squadron at Wunsdorf, West Germany.

Above:
PS853 being flown by Wg Cdr P. D. Thompson in early 1958. The Hunter of No 41 Squadron was flown by Flt Lt R. Irish, and both aircraft were based at Biggin Hill. *Crown Copyright*

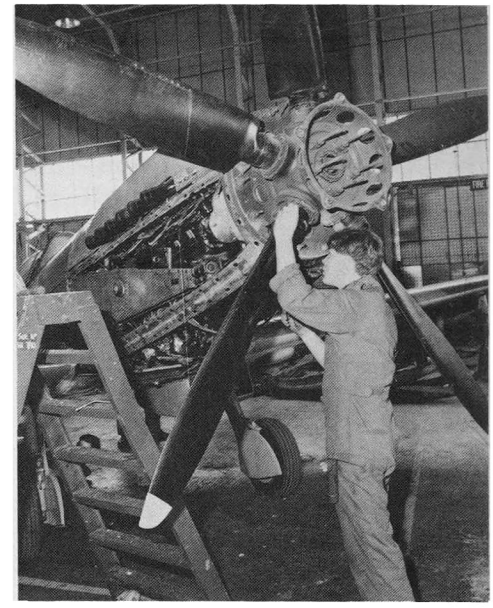
Below:
PS853 at Coltishall, probably in 1962, wearing the markings of Central Fighter Establishment.





Above:
PS915 at Luneburg on engine runs, painted PR blue. *BAe Warton*





Above:
PS915 at Celle in autumn 1948 during the Berlin Airlift standby — it was with No 2 Squadron at this time. On the propeller is Flg Off R. J. Linford and from left to right are Flg Off Bill Stuff, Flt Sgt Blackwell, Flg Off Lee, an unknown Fgt Sgt and Flt Lt Woodhouse.

Above right and below:
PS915 being dismantled at RAF Brawdy in 1984 ready for transportation to British Aerospace at Salmesbury for restoration. *BAe Warton*

By the autumn of 1948 No 2 Squadron had moved to Wahn and PS915 then took part in Berlin Airlift patrols from Celle. Unfortunately, during the following year, as a result of a serious accident, it underwent lengthy repairs and was returned to the UK. After a period in store it was issued to the Met Flight at Woodvale on 4 June 1954, as a replacement for a crashed aircraft (PM651).

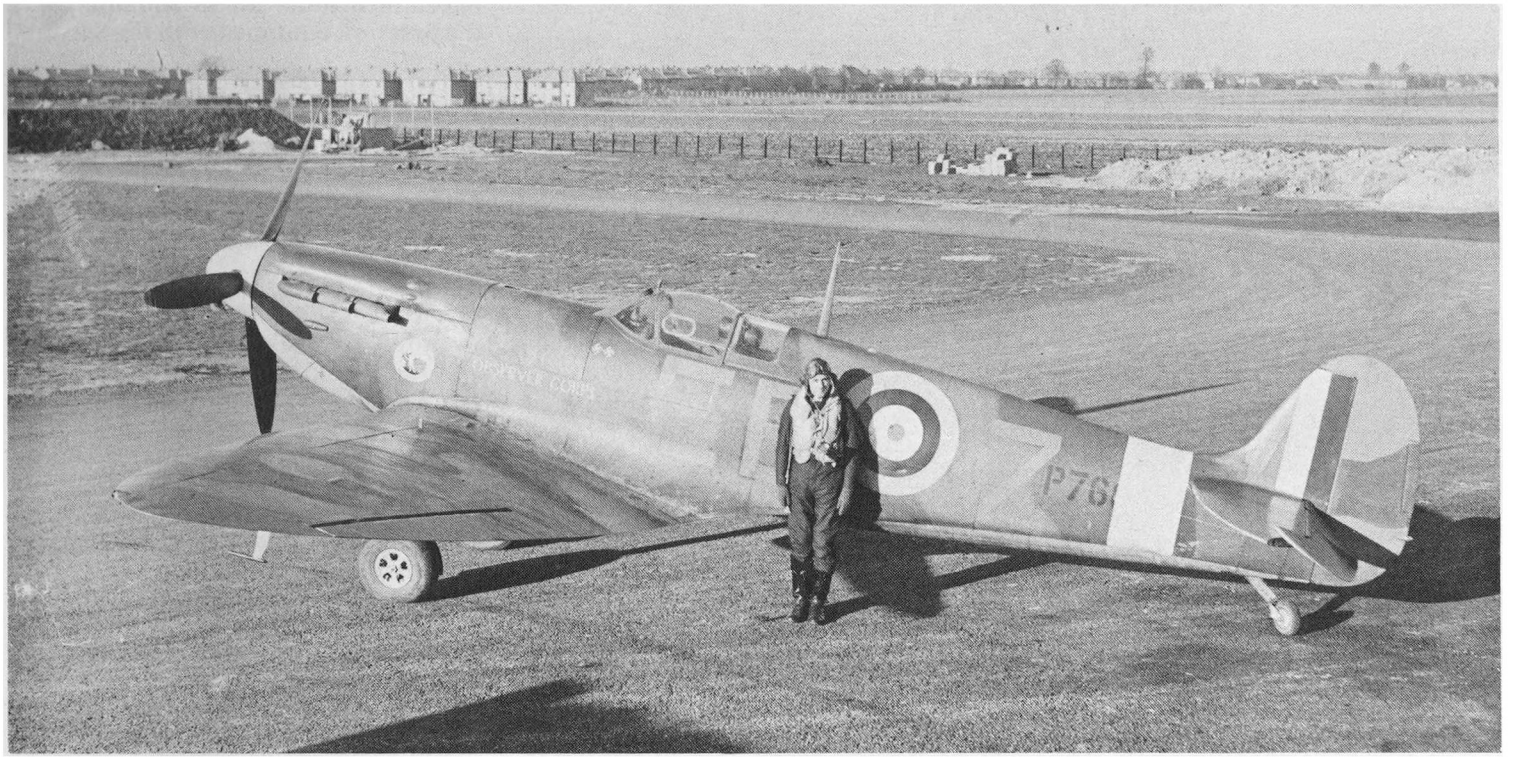
When the Met Flight re-equipped with Mosquitos in 1957, PS915, in company with PM631, was flown to Duxford on 14 June 1957 by Alan Grummet, one of the Met Flight pilots. It was then flown from Duxford to Biggin Hill by Gp Capt James Rankin on 11 July 1957, in formation with PM631 and PS853, for the formation of the Memorial Flight.

However, its stay on the Flight was very brief. On 31 August it was allocated to West Malling for ground display use and then, when West Malling closed, to Leuchars as a gate guardian. In 1967 it was taken to Henlow for renovation and then used in non-flying sequences for *The Battle of Britain*. After filming it was transferred to Brawdy, again as a gate guardian.

Unlike so many units, where the gate guardians are sadly and often disgracefully neglected, Brawdy took very good care of PS915 — it was moved into a hangar during the winter. In 1984, encouraged by Air Vice Marshal Ken Hayr, then AOC of No 11 (Fighter) Group, PS915 was moved to the Salmesbury workshops of BAe. There it was painstakingly restored and modifed to take a Griffon 58 (from a Shackleton) in place of its original Griffon 66. When it flies again during this summer of 1986 it will have a fatigue life to take it well into the next century.



Commemoration



Above and right:
The original EB-Z *Observer Corps* (P7666), which was the aircraft flown by Sqn Ldr D. O. Finlay, CO of No 41 Squadron at Hornchurch in late 1941 and early 1942. The photograph (February 1941) shows his two 'victories' of late November 1940.
Imperial War Museum

Squadron Codes carried on Memorial Flight Aircraft

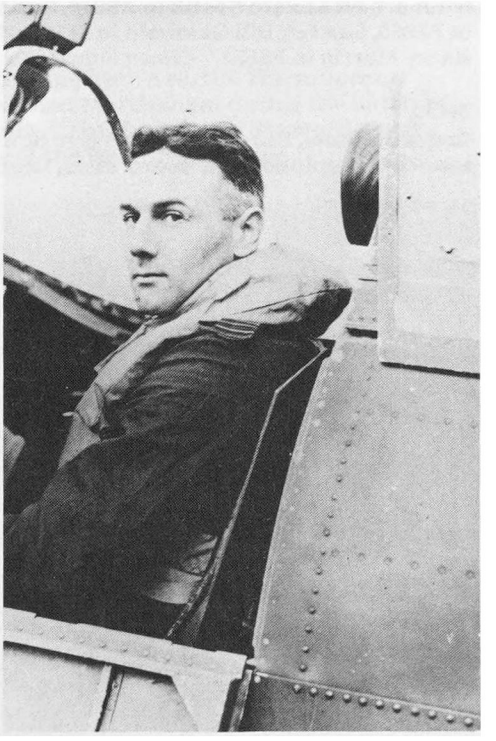
The codes carried on BBMF aircraft are representative of those carried by squadrons at various times throughout the war and not just during the Battle of Britain. They are changed at regular intervals to give a wide representation of the squadrons, their aircraft and other significant events.

EB-Z *Observer Corps*
The code is representative of a Spitfire — P7666 — of No 41 Squadron based at Manston and Hornchurch at the time of these markings. P7666 was a presentation aircraft sponsored by the Observer Corps. The Royal Observer Corps celebrated its 60th anniversary in 1985, which was the reason for painting P7350 in the Corps markings. The original aircraft, P7666, was transferred to No 54 Squadron in February 1941 as KL-Z and was shot down in flames over the Channel on 20 April 1941.

BP-O *In Memory of R. J. Mitchell*
This represents a Spitfire (X4936) of No 457 (Australian) Squadron based at Bagington and Jurby, Isle of Man at the time of these markings. This is another presentation aircraft, sponsored by Mr Fred Pearson, the director of the American Clinic in Vienna attended by R. J. Mitchell shortly before his death. 5 March 1986 was the 50th anniversary of the first flight of the Spitfire and although the Flight has no photographic evidence of the precise R. J. Mitchell inscription, it was decided to use these markings on AB910 as a tribute to both the aircraft and its designer. The 50th anniversary of his death is 11 June 1987.

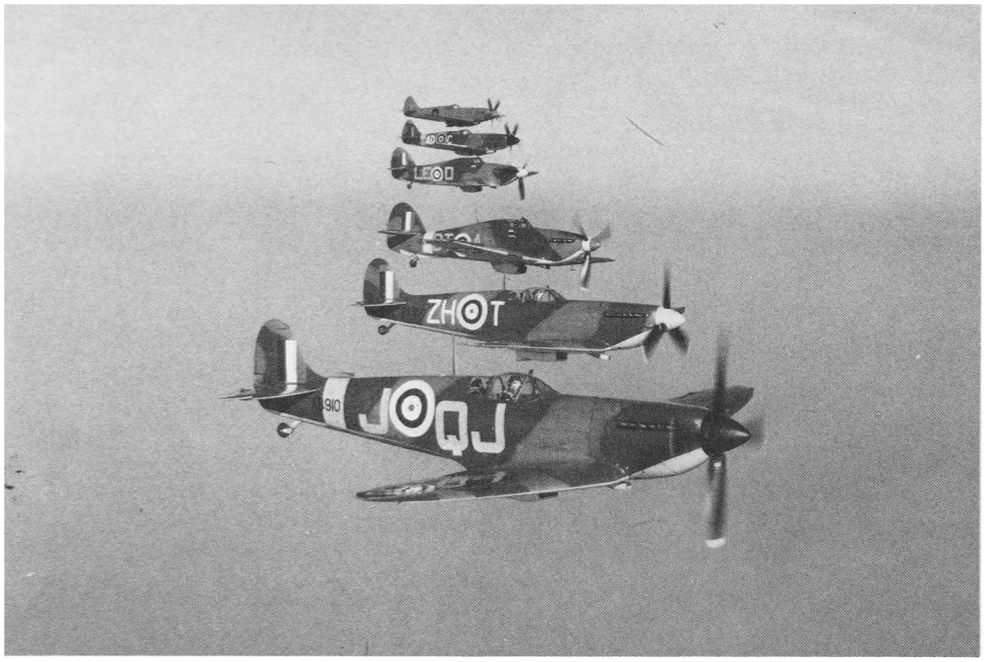
DL-E
The colour scheme and markings on this aircraft, PM631, commemorate a Mk XIV Spitfire of No 91 squadron at the time of the D-Day invasion — hence the black and white bands on the wings and fuselage. This aircraft, along with the Flight's Hurricane and Lancaster, flew over the beaches of Normandy on 6 June 1984 as part of the 40th anniversary celebrations of the D-Day landings.

XT-M
This code has a fascinating history. No 603 Squadron, coded XT-, moved from Turnhouse to Hornchurch on 27 August 1940. Two days later XT-M — Spitfire Mk I L1021 flown by Flg Off R. H. Hillary — was badly damaged by a Bf109 near Lympne. Although Hillary



managed to force-land in a cornfield, XT-M was a write off. The next replacement aircraft assigned the code XT-M was X4277. At 10.04hrs on Tuesday 3 September 1940, XT-M flown by Flg Off Hillary was shot down over the Channel by Hptmn Bode in a Bf109 of 11/JG26. Hillary baled out and was rescued by Margate life-boat but he was terribly burnt. Richard Hillary is perhaps better known as the author of the classic book *The Last Enemy* and he was killed in a night-flying accident in

January 1943. XT-M was commemorated on the Memorial Flight's Spitfire AB910 in 1983 as a memorial to Richard Hillary, although it would have been more suitable for P7350 to have carried the code instead — P7350 joined No 603 Squadron at Hornchurch just a few weeks after Hillary was shot down and so carried the XT- code in operational service.



Above:
All six airborne — the memorable day was 25 October 1973 from Coltishall. From the front are Flt Lt Pete Gostik in AB910, Sqn Ldr Ernie Jones in P7350, Flt Lt Wally Epton in PZ865, Sqn Ldr Bill Gambold in LF363, Wg Cdr Dave Seward in PM631, and Flt Lt Harry Martin in PS853. *Crown Copyright*

Below:
Codes on show. Hurricane PZ865 is in Sqn Ldr Stanford-Tuck's code, with his two-colour spinner and 'score' along the canopy rail. *Crown Copyright*

OV-B
Commemorated on Spitfire P7350, this code represents a Spitfire of No 19 Squadron at Duxford throughout the Battle of Britain. No 19 Squadron was the first unit equipped with the Spitfire.

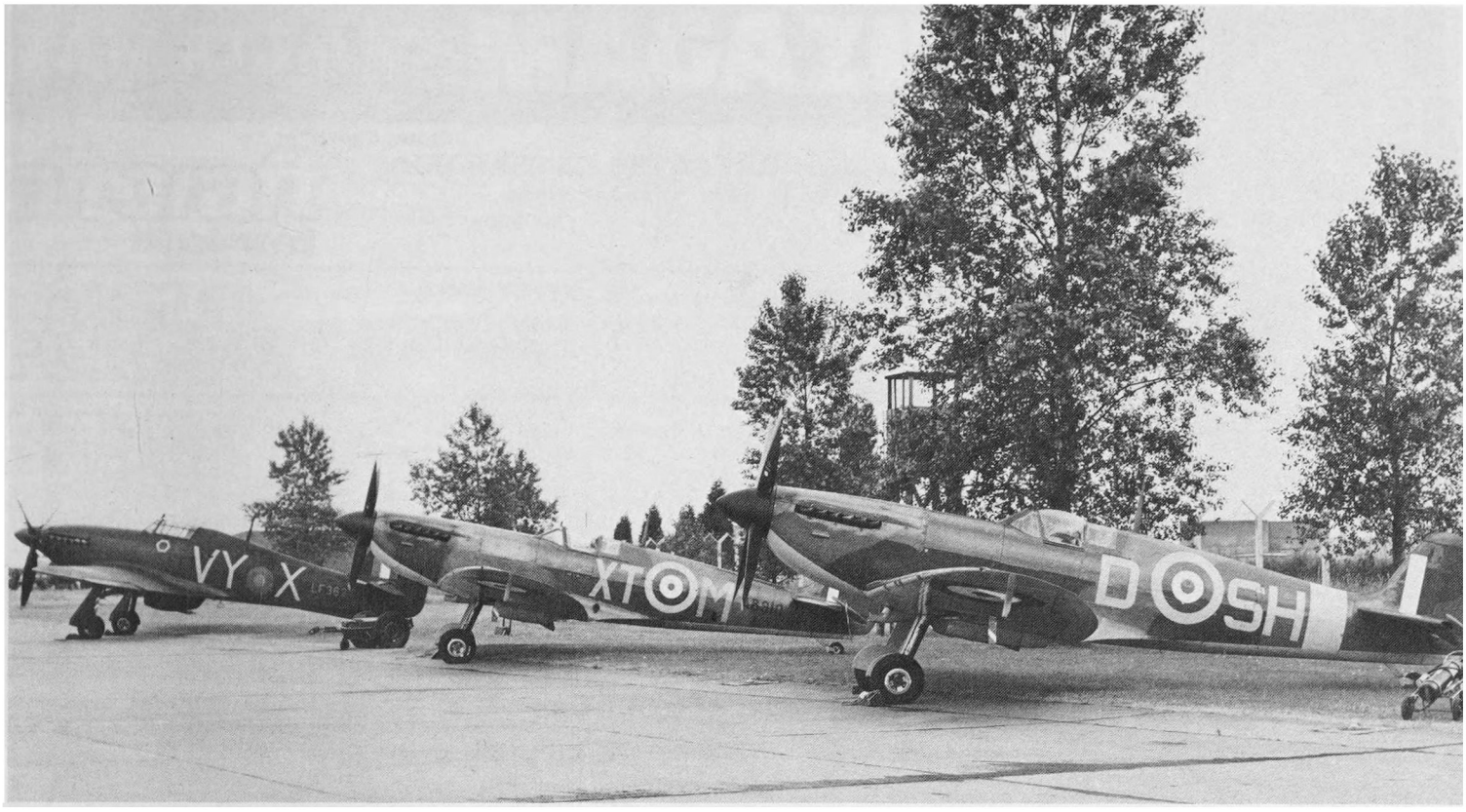
SH-D
This code, again commemorated on Spitfire P7350, represents a Spitfire of No 64 Squadron which operated from Kenley, Leconfield and Coltishall during the Battle of Britain.

ZP-A
The code of No 74 squadron, which operated from Hornchurch, Coltishall and then Biggin Hill during the Battle, was commemorated on Spitfire PS853.

QJ-J
Commemorated on Spitfire AB910, it was the code of an aircraft of No 92 Squadron that operated from Pembrey and then Biggin Hill.

ZH-T
ZH-T was the code of No 266 Squadron when it had re-equipped with Typhoons at Wittering in mid-1942 and was commemorated incorrectly on Spitfire P7350 — it was applied by mistake while the aircraft was in the museum at Colerne and restored to that code after the filming of *The Battle of Britain*. The correct code for No 266 Squadron when equipped with Spitfires was OU-.





VY-X
LF363 was painted in the black colour scheme and codes of a Hurricane night fighter of No 85 Squadron, which operated from Debden during the Battle. The Flight has a photograph of this aircraft with its pilot, Flt Lt V. Wheeler, who was awarded the Military Cross during World War 1 and the Distinguished Flying Cross with No 85 Squadron during World War 2.

JU-Q
JU-Q is the code of No 111 Squadron, the first unit to receive the Hurricane, commemorated on PZ865. During the Battle, 'Treble One' operated in turn from Croydon, Debden, Croydon and then Montrose.

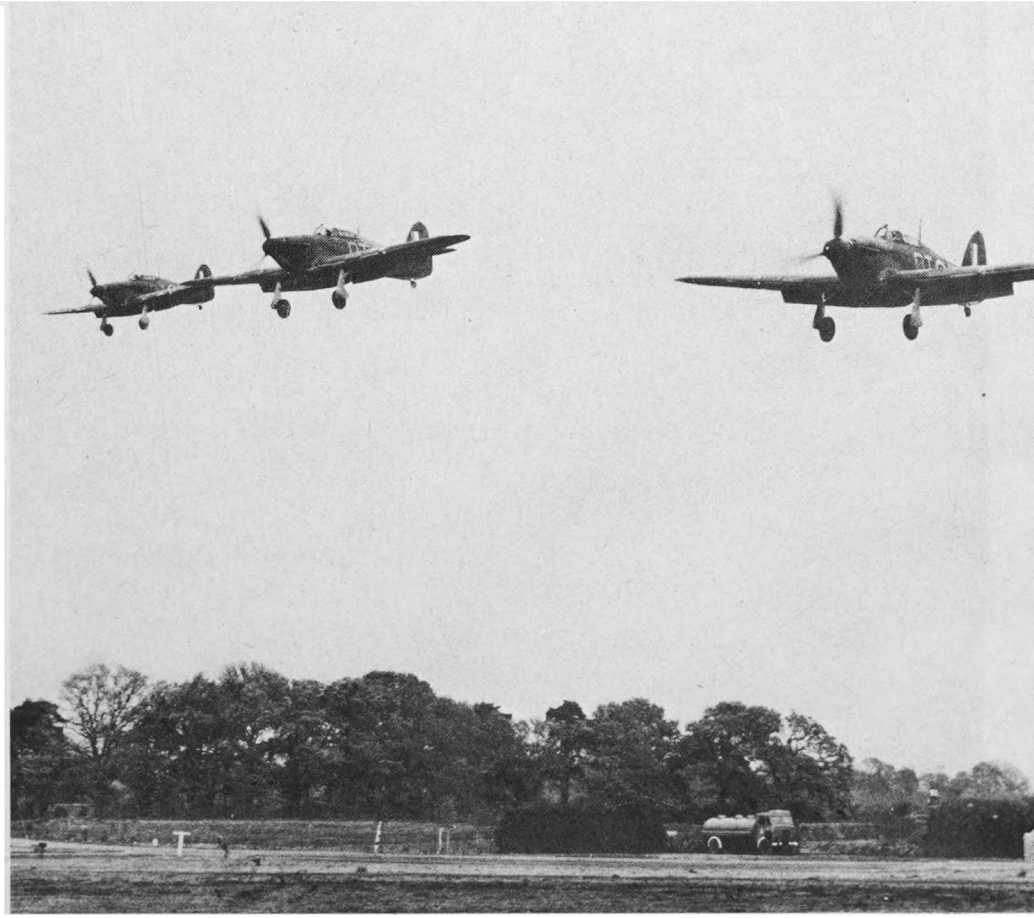
LE-D
The code of Sqn Ldr Douglas Bader's Hurricane on No 242 (Canadian) Squadron which was based at Coltishall and then Duxford during the Battle. It was commemorated on LF363.

GN-F
This code commemorated on LF363, represents a Hurricane of No 249 (Gold Coast) Squadron which operated from Church Fenton, Boscombe Down and, by September of 1940, from North Weald.

DT-A
The code of Sqn Ldr Bob Stanford-Tuck's Hurricane on No 257 (Burma) Squadron, which operated from Debden in August and September and then moved to North Weald in late October 1940. It was commemorated on PZ865.

Above:
More codes — from the left are LF363, AB910, P7350. Unusually, the latter had a four-blade propeller at this time.

Below:
A trio of Hurricane Is of No 257 Squadron returning from a sortie. The squadron operated from Northolt, North Weald, Debden and Martlesham during the Battle of Britain; and was commanded from 11 September 1940 by Sqn Ldr Stanford-Tuck, whose aircraft DT-A was represented by one of the BBMF Hurricanes.





A summer morning . . . scattered cumulus cloud . . . and a Hurricane turns steeply away: LF363 on a flight whilst based at Coltishall.
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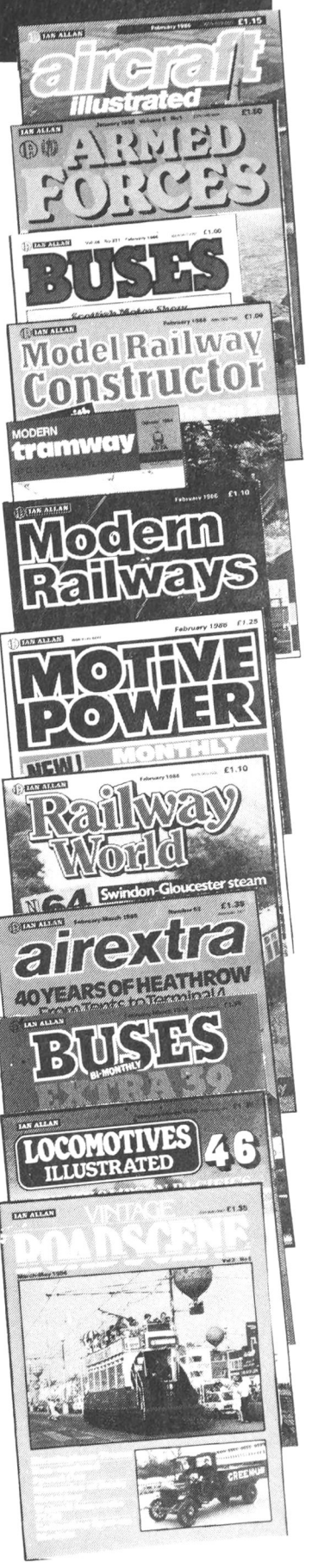
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