GEOFFREY

G R de Havilland, OBE, 1910-1946

This account of the life of Geoffrey de Havilland junior is the transcript of a lecture given by David Tipper to the Hatfield Branch of the Royal Aeronautical Society on 18th June 1997.

The lecture was illustrated with many slides. This transcript is illustrated with a small number of different pictures, all those of aeroplanes being by courtesy of BAE Systems and taken from their on line resource.

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The de Havilland Aeronautical Technical School Association
with the help of David Tipper.

The speaker was introduced thus:

David Tipper became obsessed with aeroplanes at the age of six and by the time he was ten had decided to make a career in aeroplane design. He joined the de Havilland Aeronautical Technical School at Hatfield as an Engineering Apprentice in 1950. He entered the Aerodynamics Department, then under Mr Clarkson, in 1955 and worked on many aircraft types and projects, mainly Comet 3 and 4, Trident, 125-700 and -800, and 146. In 1985, he joined the Future Projects Department where he was responsible for pre launch studies and design for the 146-300, 125-1000 and New Business Jet. He retired in 1993 but in 1995 he joined Raytheon Corporate Jets at Hatfield and later Harrow where he contributed to the configuration definition of the forthcoming Hawker Horizon 4000, retiring again in 1996.

INTRODUCTION

If there is such a thing as a golden era, then that of the de Havilland Aircraft Company was between the inception of the Mosquito and the Comet 1 crashes – about 1940 to 1954. During that period, the company transformed itself from a successful constructor of light aircraft and their engines that had been slowly and carefully developing its technology, into a world leader in both airframes and engines. But, until the Mosquito, the company had not succeeded in turning technological advance into sales success. As Chief Test Pilot from 1937 until his death in 1946 Geoffrey de Havilland Jr. was one of the key figures in this explosive advance and his name is particularly linked to the Mosquito and the DH 108. The main object of this lecture is to illustrate his part in this achievement.

Geoffrey Raoul de Havilland, the eldest of three sons of Geoffrey and Louie de Havilland, was born on 18 February 1910 in the village of Crux Easton near Newbury where his grandfather, the Rev Charles de Havilland, was Rector. At this time Geoffrey de Havilland Senior, or dH as I shall call him henceforth, was engaged in rebuilding his first, unsuccessful aeroplane into a successful second version. This rebuilt aeroplane flew for the first time on 10 September 1910 and Geoffrey – my subject – took his first flight in his mother's arms in the following month. He was almost certainly the youngest person to have flown at the time.

Geoffrey had to wait until 1916 for his second flight, when dH decided that it was time for some air experience for Geoffrey and his brother, Peter. DH took them up in a DH 6. The

picture above shows one of the prototypes and a look at the wing tips suggests one possible reason for its nickname – "Clutching Hand" – the other possibility being that it was a very difficult aeroplane to crash. At the time, the idea was that the best and safest trainer was one which only required the pilot to intervene in its progress from time to time. Unfortunately, this was no basis for life in a Sopwith Camel, for instance, where effectiveness in combat was obtained at the expense of instability in all directions and a particular sensitivity fore and aft. Norman Macmillan wrote in 'Into the Blue' – "Here was a buzzing hornet, a wild thing, burning the air like raw spirit fires the throat".

The DH 6 was much better as a machine for taking two boys for a ride. In his autobiography 'Sky Fever' dH wrote: "They were only mildly excited at the prospect of this event, and when I got them into the air they remained totally unimpressed. Peter took no notice at all, except to spit over the side 'to see where it would go' and would have been more excited by a motor car journey, while Geoffrey, whose passion at the time was for trains, kept his eye on the railway line to see where it went." This remained Geoffrey's navigational style.

EARLY YEARS

Geoffrey was educated at Stowe School where, according to his father, he was not brilliant at work but a good long distance runner. The school was founded in 1923 so Geoffrey must have been one of its first pupils. After "a short period abroad to have some of the corners rubbed off", he became, in 1928, one of the first students of the de Havilland Aeronautical Technical School. Whilst in the Tech School, he learned to fly at the RAF Reserve Flying School that was operated by de Havilland's at Stag Lane and where he flew various kinds of Moth and DH 9J's – Armstrong Siddeley Jaguar powered DH 9's – the last of which, amazingly, was built by the Tech School in 1931. He achieved the rank of Pilot Officer.

It was during his time in the Tech School that Geoffrey had his first mild taste of test flying. Between December 1928 and September 1929, a Gipsy Moth, G-EBTD operated by the Reserve School flew 600 hours with a sealed engine as a demonstration of reliability and Geoffrey was one of its many pilots.

Having completed three years in the Tech School, Geoffrey went to South Africa for a time where he carried out aerial survey work. I have not been able to find who he worked for, where he worked or what he flew, but an

educated guess would be that he was employed by The Aircraft Operating Company in which A S Butler, the de Havilland Chairman had an interest. The AOC did aerial surveys throughout the Empire and used ADC Nimbus powered DH 9's, a twin Jupiter powered Gloster AS31 and probably other types. However, Geoffrey's surviving logbooks show neither Nimbus DH 9 nor AS 31 and the only other likely type in his experience is a Fokker Universal.

On his return to England in 1932, he became a flying instructor, first with the Tech School and then with the London Aeroplane Club, based at Hatfield. During this period he obtained a commercial pilot's 'B' licence.

TEST PILOT

And then, Captain Hubert Broad, Chief Test Pilot since the early days of the company, was sacked. Mr Clarkson – I cannot bring myself to call him Richard and dare not call him Willy, the nickname bestowed by Geoffrey – recalls: "One day, I think in 1935, a year after the MacRobertson race, Broad came up to my desk and said, 'I have just had the sack, they put Daddy Hearle on to it, he started to cry – I wanted to laugh'. The problem was 'de Havilland disease', Broad was insufficiently critical of the firm's products".

This view is not entirely consistent with another Clarkson story. Speaking of the Comet racer, he said: "The Comet planform, being almost trapezoidal, was in effect 'designed for a tip stall'. Every landing was an adventure, and disaster was only saved by the wide track undercarriage dictated by engine location. I remember a particularly 'hairy' landing on this aerodrome (Hatfield) when the wing drop was followed by a succession of ground loops with the aeroplane finishing up facing almost in the direction it had come from. Broad jumped out, saying, 'Get out, they can come and collect it. We will walk back to the bar for a brandy. This company should be rechristened Death Boxes Limited!'

Broad did not starve. After a spell of freelancing, flying for the Air Registration Board and the Royal Aircraft Establishment, he joined Hawkers as a Production Test Pilot and retired at the end of World War Two.

He was succeeded by Bob Waight, his former assistant and Geoffrey filled the resulting vacancy. It was a relatively quiet time for new types with just the DH 92 making its first flight in the spring of 1936.

The DH 92 Dolphin was an attempt to refine the Dragon Rapide. The hope appears to have been that reduced drag would allow the employment of two pilots and a more spacious cabin without loss of performance. After a few months testing during which a retractable undercarriage was tried it was abandoned with only two photographs and a few drawings remaining to show it had ever existed. Geoffrey flew it just twice.

In those days, flying was always likely to be eventful. Early in 1935, the first DH 88 Comet racer, flown by the Mollisons in the 1934 Mildenhall – Melbourne race had been sold to the Portuguese government, registered CS-AAJ and named 'Salazar' after the then dictator of Portugal. The aircraft subsequently visited Hatfield on a couple of occasions and, on one of these, dH expressed an interest in flying it. Geoffrey took his father for a quick familiarising circuit and dH then took off for a short solo flight. Observing the approach. Geoffrey cried out "he's coming in too high and too slow" paused and continued "oh no, its Friday the 13th!" The ensuing landing matched Geoffrey's expectations, a chastened dH emerged and the aircraft was hurried into the shop for repair.

The DH 86 Express Air Liner was having problems too. It first flew early in 1934 and quickly entered service. But by the end of 1935, four had been wrecked in Australia and the Australian Ministry of Defence had suspended the C of A's of all DH 86's in Australia. Then, in August 1936 a British Airways DH 86 crashed near Cologne followed by another BA machine at Gatwick in September. Imperial Airways lost one of their fleet, also near Cologne, early in 1937. Eight of the sixteen DH 86's operating in this country were then grounded and after a rapid investigation and development programme, the design was modified as the DH 86B to include a spring in the elevator circuit, higher aileron gearing, auxiliary fins and a tailplane of increased chord. Fourteen DH 86A's were modified to DH 86B and ten new DH 86B's were built, all in 1937, a considerable extra burden in a very busy year.

The main money makers at the time were the Tiger Moth, in large scale production as military and civil trainers and exported almost all over

the world, and the Dragon Rapide 7/8 seat airliner. Geoffrey wrote an amusing and informative article (rather later than this time) about Dragon Rapide production flight test for the de Havilland Gazette. He started by poking fun at organisations (unnamed) where the kin and the merry boys who fly them."

It is all very methodical and not really so different to how it is done today except that it would all be packed into three or four much longer flights.

Meanwhile, the firm was preparing itself for

Dragon Rapide G-AERN of West Coast Air Services in March 1937

weekend starts on Friday morning and at the 'so called' editor of the Gazette, presumably Martin Sharp, Head of Public Relations, before eloquently describing the large scale and professionalism of the production organisation. He next describes the pre-flight checks and first flight where handling, engine, systems – such as they were – and structural vibration are checked.

Half an hour is all he expected to be needed to clear snags and the machine was then loaded to maximum weight and aft centre of gravity for its second flight on which stability and ability to trim were checked. He is clearly very proud of the Rapide's stability on aft CG. Then there was a forward CG flight to check ability to trim at that end of the range. Then came a radio flight with the radio manufacturer's engineer aboard. After a clean-up came a performance flight, then into the Paint Shop for customer livery to be applied, another check flight and then customer acceptance. And then, as Geoffrey put it, "away she goes to Singapore or Cape Town or over those lovely pinewoods of Scandinavia to meet others of her kith and

a technological and market leap forward. The DH 88 Comet had proved itself as a 'technology demonstrator' by showing the benefits of clean aerodynamics, retractable undercarriage, variable pitch (or in that case, two pitch) propellers and flaps, beyond reasonable doubt.

Even before the Mildenhall – Melbourne race, a licence for the Hamilton variable pitch propeller was obtained and, by 1937, a range of sizes was available to suit engines from the Gipsy Major of 130 hp up to the largest engines.

Major Halford had designed two new engines, the 90 hp Gipsy Minor and the 525 hp Gipsy Twelve or Gipsy King.

The company was also well aware of the limitations of contemporary glues and assisted Dr N A de Bruyne to set up a company, Aero Research Ltd to develop urea formaldehyde resins. From this came wider developments such as Redux, wood-metal and metal-metal adhesives so important to later de Havilland aircraft.

These developments and others, such as the

plywood and balsa sandwich fuselage construction, provided the technology available for four prototypes which each made their first flights in the summer of 1937 – just sixty years ago.

First to fly was the DH 91 Albatross on 20 May in the hands of Bob Waight. The Albatross had its origin in the October 1934 Mildenhall – Melbourne race. The Comet had won, but close on its heels was a DC 2 of KLM, carrying fare paying passengers. No time was lost before the Air Ministry was being lobbied for support for a prototype high speed transport aircraft. Eventually, on 21 January 1936, the Ministry placed an order for two DH 91 Albatross aircraft at a price which was only half the cost.

Albatross prototype G-AEVV showing revised fin shape

Very broadly speaking, the Albatross was a Comet scaled to be six times as heavy and with six times the power. The engines were four of the new Gipsy Twelve and variable pitch propellers were fitted. The wing construction was all wood with diagonal planked skin, like the DH 88 whilst the fuselage was a plywood and balsa sandwich as was later to be used for the Mosquito.

Development of the Albatross was not without problems. The original tail unit proved unsatisfactory and a complete redesign was necessary. Then, on 31 March 1938, Geoffrey made a wheels up landing on the first aircraft, E2, later G-AEVV and, on 27 August that year, he experienced a more serious mishap in the second aircraft, E5, later G-AEVW.

He had returned early from a successful day's racing the TK 2 at Southend to do heavy weight take-offs. The grass at Hatfield was bumpy and during the landing roll, the cabin door was seen to fly open and the fuselage snapped across the now open doorway. The aircraft came to a halt with its nose high in the air and the engines still running. With Geoffrey in the cockpit was Terry Dunworth, an AID Inspector, the aeroplane being Air Ministry property since they had paid for half of it. As the fuselage broke, the control cables pulled the control columns back, dealing Dunworth an unpleasant blow! The escape hatch in the cockpit was seen to fly open and Dunworth shot out. He disappeared from view and was next seen rolling along behind the tail in a tight crouch. Meanwhile, Geoffrey sat on the edge of the escape hatch asking if anyone had a rope. No one did and eventually, when it was apparent that there was no fire, Geoffrey descended the cabin and came out. Typically, he was calm, and there were no harsh words for the Stress Office!

The following Monday, two young aerodynamicists had to report to Mr Clarkson that a lack of familiarity with the camera they

were operating meant that no film of the incident existed. I understand that they were made to feel very uncomfortable!

Despite these setbacks, E2 went to Martlesham Heath in September 1938 for official tests and received its C of A on the 29th September. Nevertheless, the AAEE pilots criticised the elevator and rudder as very heavy. The measured fuel efficiency however was outstanding as was appropriate for a transatlantic mailplane.

Meanwhile, Imperial Airways had ordered five Albatross for European passenger service and these machines were delivered between November 1938 and June 1939. The Albatross or, to use its Imperial Airways/BOAC fleet name, Frobisher did not enjoy a long life and by July 1943, the original seven strong fleet was down to two, which were then scrapped. Despite its fragile structure and undercarriage, the Albatross was a fast and useful transport which had set several records during its brief pre-war service, performed courier services to Egypt and India and finally, ran shuttle services to Shannon and Reykjavik.

The Albatross can be judged a partial success, demonstrating as it did high speed and efficiency. But the airlines were looking for higher reliability and the strength and durability that were beginning to be shown by the best metal airframes. The DC 3 had still to show its ability to reach an airframe life of 80000 hours but it had captured a dominant position in the market all over the world except for the European countries with a large domestic manufacturing industry to protect: Britain, France, Germany and Italy.

Next to fly, at 6pm on 18 June (60 years to the minute before the start of this lecture), was the DH 93 Don, a multi-purpose trainer designed to Air Ministry Specification T 6/36. It used one Gipsy King engine and, of course, a variable pitch propeller. The pilot was Geoffrey, his maiden first flight and its development became Geoffrey's responsibility. Two hundred and fifty had been ordered and, no doubt, further large orders were hoped for as part of the accelerating re-armament programme.

On 22 June dH himself made what was to be his final first flight in the DH 94 Moth Minor, designed to be a cheap but efficient club trainer and private owner aircraft which could recapture the spirit of the original Moth. It was powered by the new Gipsy Minor but, unlike the larger aeroplanes, had a fixed pitch propeller and fixed undercarriage as befitted its price and market.

CHIEF TEST PILOT

In July, Bob Waight made the first flight of the Tech School TK 4 racer. The TK 4 was another design that aimed for high performance with retractable undercarriage and variable pitch propeller, this time powered by an uprated Gipsy Major. Its purpose appeared to be to compete effectively against the Mew Gulls and Hawk Speed Sixes despite the power disadvantage of using a Gipsy Major instead of a Gipsy Six.

And then, on 1 October, Bob Waight was killed when he stalled in a turn demonstrating the TK4 to 'Flight'. Accounts vary, but it seems that the engine stopped and he was attempting to lower the undercarriage using the hand pump when he lost it. Waight was thrown clear and killed.

Geoffrey was immediately promoted to Chief Test Pilot, a post he was to hold for the rest of his life. He was 27 years old. With the assistance of George Gibbins and Guy Tucker he took over a major test commitment, most notably Albatross development.

Already it was evident that the Don was a lemon. When tested at Martlesham Heath in September 1937, it had a large wing drop at the stall accompanied by aileron snatch, poor view, difficult entry, excessively long take-off distance and very heavy elevators. The undercarriage track was too narrow having been determined by a requirement for the aircraft to be transported on road trailers standing on its own wheels. The oleos tended to stick and Dons would be seen parked, leaning drunkenly.

Unsurprisingly, the Don was rejected as a trainer and the order reduced to 50, to be delivered as communications aircraft. With its relatively high speed and smooth engine this might have seemed a fitting use. But still Martlesham did not like it, criticising not only take-off and view but the rudder bias and the cockpit layout. The Martlesham Don L2391 then suffered a throttle linkage failure and crashed. Even so, ten were delivered to RAF Station Flights and one to 24 Squadron at

Hendon. Possibly the only Don to achieve anything useful was the machine used to test an early reversible pitch propeller.

In short, the Don was a mediocre aeroplane built to a specification that should never have been written. It was not a good aeroplane to have on your CV!

Returning to the DH 94 Moth Minor, this was an aeroplane that had success snatched from it by the war. It was the least technically ambitious of the four but it met the needs of the only substantial civil market in Britain.

Trying to read between the lines, I suspect that the Moth Minor had a much more difficult gestation than we have been led to believe. In the late nineteen twenties, the Moth had put the company on a sound business footing. But, as is almost inevitable if a product is developed continuously, it gets heavier and more expensive so that, by 1931, the Tiger Moth had more than double the power and was nearly 50% heavier than the 1925 prototype. It is surprising that the price increase was quite modest — from £900 to £1,095, presumably the result of quantity production. But that was still a lot of money.

In 1931, the DH 81 Swallow Moth was built – a clean, efficient low wing monoplane – and abandoned despite excellent performance, killed by the depression or perhaps price. A place in the club trainer market was maintained by the Moth Major, a Gipsy 111 or Gipsy Major powered version of the original wooden Gipsy Moth of 1928. However, this market had to be shared with the Miles Hawk and competition from the BA Swallow was also significant.

In 1937 came the Moth Minor. To keep the price of a Moth Minor down to £575 – about one and a third times the price of a house in Hatfield Garden Village – an independent design and manufacturing organisation was set up to bring on young designers and engineers and to keep overheads down. It seems to have been dH's pet project and probably would not have happened otherwise. Many people in the team reached senior positions in later years, notably John Cunningham and the late Phil Smith.

John Cunningham, who had learned to fly in Avro 504's with the Auxiliary Air Force, was invited by dH to assist Geoffrey with clearance of the first production Moth Minor. This he proceeded to do but in due course, he felt the need for Geoffrey's approval. Geoffrey agreed, with a good deal of reluctance, to fly the machine and set off to try aft centre of gravity handling and spinning. John took the back seat to save loading ballast.

On the first spin to the right the engine stopped and the machine entered a flat spin.

Publicity photograph to show the ease of folding the wings of a Moth Minor. The location is outside the London Flying Club restaurant.

Geoffrey's attempts at recovery were ineffectual and he invited John to have a go. This was also unsuccessful so John said "we have to get out" and pulled himself out. After waiting to get clear of the aeroplane, he opened his parachute and then saw Geoffrey escape by standing with one foot on a wing and using his parachute to pull himself clear.

Things now started to get interesting. The aircraft stopped spinning, the engine restarted and John watched the aircraft complete three circles over a large field where two people were horse riding, before hitting trees and catching fire. John landed near the by now nearly burnt-out aeroplane and, having declined help from the horse riders, bundled up his parachute and set off towards the road wondering what had happened to Geoffrey. Thinking "I know where he'll go" John stopped a passing car and made for the 'Chequers' (Crooked Chimney) at Cromer Hyde. Geoffrey was already there, help arrived from Hatfield and a party followed.

There followed three months of intensive stall investigation for John Cunningham, the first of several such investigations during his career, before the problem was solved by restoring rudder travel, some of which had been lost on the production aircraft, increasing the rudder area under the tailplane and adding strakes on the fuselage, ahead of the tailplane, like those on the Tiger Moth.

The story also has a moral: switch off before you jump!

FLAMINGO

Geoffrey had been Chief Test Pilot for little more than a year when he made the first flight of the DH 95 Flamingo on 28 December 1938. George Gibbins was co-pilot. Design of the Flamingo was the responsibility of a new Chief Designer, R E Bishop, generally known as Bish.

On that flight, Geoffrey retracted the undercarriage immediately after becoming airborne, and, on landing, he was able to report favourably on its handling. When Martlesham came to test the Flamingo for its C of A in July 1939, they too were impressed, particularly with its single engine performance. They also liked the panel mounted control column but both engines sharing a single set of instruments was not liked and had to go!

Once again the major aerodynamic development was to do with the tail and, after trying a central fin, enlarged fins with horn balanced rudders were found to be satisfactory.

The prototype, registered G-AFUE, received its C of A on 30 June 1939 – seemingly before its official trials at Martlesham – six months and two days after its first flight. Compared with the sixteen months taken to certificate the Albatross, this was a most creditable performance.

The Flamingo's nearest competitor was the

First Flamingo, in the colours of Guernsey & Jersey Airways in July 1939

Lockheed 14 Super Electra which had entered service at the end of 1937. The performance of the Lockheed 14 was similar to that of the Flamingo but it did not have a good reputation for handling. The sales chances of the Flamingo at the expense of the Lockheed machine might have seemed good were it not for the fact that the Lockheed 14 had failed to find sales in its home country against the competition of the DC 3. War came and the contest was never held. Small scale production continued, three for the RAF and eleven for BOAC and some further development was undertaken leading to a small span increase, bigger ailerons and reduced dihedral, flap span and rudder horn balance size.

After the war, only one Flamingo returned to service so the design never really had a chance to prove itself; another might-have-been.

The Flamingo had one other claim to distinction: it was the first de Havilland aeroplane for more than ten years to have an outside engine supplier using, as it did, the nine cylinder sleeve valve Bristol Perseus.

At the outbreak of war, Geoffrey was still only twenty nine but he could claim to be an experienced Chief Test Pilot with four types brought to production status. The lemon could now be regarded as good experience.

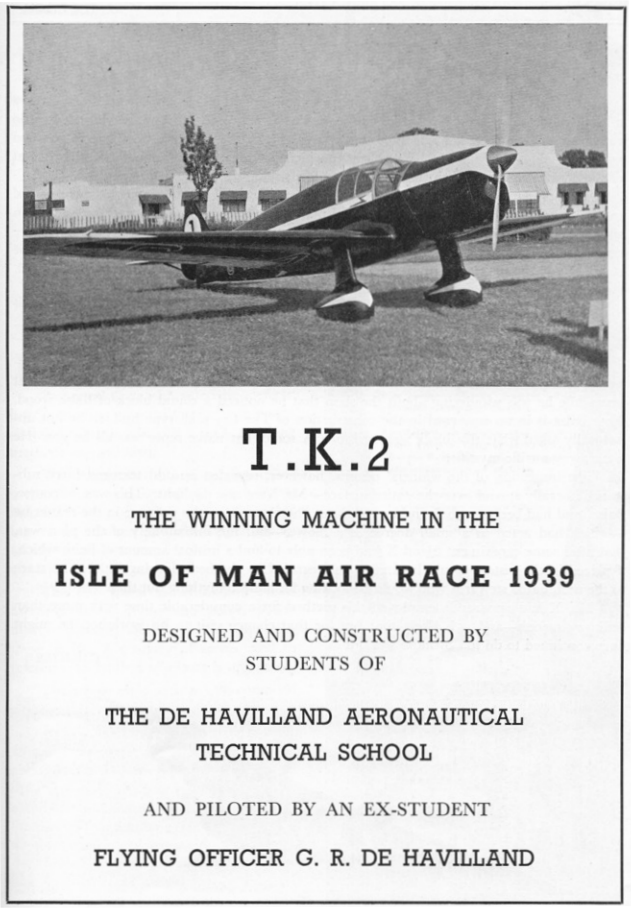
Two other pre-war activities are worthy of mention.

Geoffrey should have had one more first flight under his belt – that of the Tech School TK 5. However, despite his best efforts, the TK 5 could not be induced to unstick and plans to fit a larger foreplane were frustrated by the war. This failure was a serious source of embarrassment to Geoffrey because a first flight earned a bonus of £50. On the expectation of this bonus, he had negotiated a temporary increase of his overdraft with Mr Girling, Manager of the Aerodrome Branch of Barclay's Bank. Geoffrey was terribly worried!

Air racing was a major interest in the pre-war years, helping to keep the firm's aeroplanes, engines and propellers in the public eye. Geoffrey competed in many races and there is time to mention only a few. He flew twice in the King's Cup: in 1934, he came fifth in the TK 1, G-ACTK whilst in 1936, he accompanied his father in the prototype DH 90 Dragonfly, G-ADNA and placed eighth. The 1936 race was flown in poor weather and dH was asked after the finish how he had fared. DH replied that he and his son had had a very pleasant trip, omitting to mention that they had narrowly missed collecting a sheep or two from the top of a Cumberland fell, an error he admits to in 'Sky Fever'.

After becoming a Test Pilot, Geoffrey regularly raced the TK 2 which was rebuilt in 1938 with reduced wingspan and a new engine His successes in the TK 2 included first place in the Heston to Cardiff Race in both 1937 and 1938 and first in the Isle of Man Air Race in 1939. He also took the TK 2 abroad on at least one occasion to Deauville. Setting off home he came down to sea level for the trip across the Channel. The locals thought he had gone down and launched the lifeboat to search in vain but he arrived safely at Hatfield and put on a very good show of aerobatics before he landed.

During the first year of war, the firm was kept busy turning out Tiger Moths and Oxfords in large numbers plus a steady flow of Dominies – the RAF name for the Rapide. In the summer of 1940, another flight test activity expanded the experience of the de Havilland test pilots. With a minimum of warning, the company started to receive large numbers of battle damaged Hurricanes that had to be repaired, air tested and returned to their squadrons with the utmost urgency. During one such test, the canopy broke free and Geoffrey was struck on the nose. Badly shaken, he did well to return safely.



MOSQUITO

Meanwhile, although production was running at a high rate, de Havilland had not achieved a major success since the Dragon Rapide of 1934. The main source of income from airframe manufacture came from someone else's design – the Airspeed Oxford – an embarrassment that was only partially eased by the pragmatic decision to buy the Airspeed company. Something had to be done.

Characteristically, the company had been looking ahead even when the present was proving rather a struggle and had been studying the question of bombing economically – how to destroy the enemy's resources without consuming one's own. The Mosquito story has been told many times and is briefly as follows – de Havilland did not believe that the P13/36 Specification which led to the Manchester and Halifax would result in a good aeroplane and managed to persuade Sir Wilfrid Freeman, Air Member for Development and Production of the

merit of an unarmed twin Rolls Royce Merlin powered bomber.

Sir Wilfrid became an enthusiastic protagonist and despite much opposition on the Air Council the firm received a contract for fifty bombers to Specification B1/40 on 1 March 1940. Due to the foresight shown by not using materials likely to be in short supply work was only briefly interrupted as the events of the summer of 1940 unfolded and Geoffrey was able to fly the prototype, curiously painted yellow and carrying the civil marking E0234 since it was still officially a private venture, on 25 November 1940. John Walker, Chief Engine Installation Designer was his observer. There were few major snags and on 29 December 1940, the prototype was demonstrated to Lord Beaverbrook with other new types at Hawker's Langley airfield.

Interest in the Mosquito started to mushroom. In January 1941, Flight Lieutenant John Cunningham as he then was, was sent for by the Chief of Air Staff, Sir Charles Portal, and ordered to go to Hatfield to assess the Mosquito as a potential night fighter. John had been called up in August 1939 and started the war on Blenheim night fighters. In November 1940, he had been one of the first to convert to Beaufighters. The assignment was most irregular, ordinary squadron pilots were never allowed to fly a new type before A&AEE, by then at Boscombe Down, had approved it and the instructions had to come from the highest level.

After a short briefing from Geoffrey, Cunningham took the Mosquito out, accompanied by an observer known as 'Peg Leg Tony'. Having taken off without difficulty, he started to change hands since the throttles and undercarriage lever were on opposite sides. Immediately, the throttles started to slip back and there followed a few uncomfortable moments over St Albans. Otherwise, the flight went well and John was able to report that the Mosquito would make a good night fighter with far more performance than the Beaufighter. He remarked to Geoffrey about the slipping throttles and received the reply – "Oh! sorry, I meant to mention that!"

On 19 February 1941, W4050 as the prototype was now serialled, was sent to Boscombe Down for official trials. These culminated in the famous words by Fred Rowath, Chief Technical Officer of AAEE: "I take my hat off to 387 mph".

This phrase set the seal. The elusive breakthrough had been made. Which called for a party; a party at which Mr Clarkson uncharacteristically let the side down. In his own words, "On the Monday, when we knew the speed and what it implied, Geoffrey de Havilland said '…a party!, we must have a party at the George!' We invited Gordon Slade,

Mosquito E0234 outside the Assembly Building on 19th November 1940

Allen Wheeler, and Fred Rouse to the party, and of course it went right out of hand – it went absolutely out of hand. I was supposed to be the chap that was capable of keeping it in bounds, but it was quite impossible! Geoffrey de Havilland was found to be running up and down the corridor with nothing on …and…er...well you have to remember that there was a lot of pent up something that had to be released here. We knew that it was a terrific occasion! The landlord said 'de Havillands – out of the George! No de Havilland people shall come to the George at Amesbury ever more!' So that was it – we were out."

The next day, there was a problem when the controls were found to have suddenly stiffened up. After some time spent in fruitless investigation, a rigger called out: "It's all right, she's broken her back!" It was far from all right but the repair was quick and effective. Shades of the Albatross!

Development changes were few. There were the fuselage strengthening strakes, of course. The nacelles were lengthened to remove a buffeting problem, a change which involved dividing the flaps and reducing their area. The exhaust manifold was redesigned to solve an overheating problem. The wing span was increased from 52 ft to 54 ft 2 in, though I do not know the reason. Aileron covering was changed from fabric to aluminium alloy, probably to reduce panting at high airspeed. A twin tread tyre was introduced on the tailwheel to prevent shimmy.

Following a flight when Bish, who had gone aloft as a passenger to sample things for himself, had to lower the undercarriage using the hand pump which turned out to need 500 strokes, improvements were made to the hydraulic system which had been closely based on the Oxford's, a suggestion of Geoffrey's.

Surprisingly for a company which had a pilot/designer at its head, Geoffrey had little influence on design decisions. The Mosquito cockpit was cramped and the pedals were offset. The elevator trimwheel was low down and out of sight and the fuel cocks were awkwardly located. Access was by a ladder with very widely spaced rungs which had to be climbed with one's back to it!

The Mosquito's speed and manoeuvrability have been much praised and also overstated. There were faster aeroplanes, though not much faster, and the Mosquito was no dog fighter. But, not being perfect is not sufficient to prevent the Mosquito being one of the great aeroplanes of all time. In each of its four major roles, it was the best. It was a fine pilot's aeroplane, displaying the lightness and harmony of control which was becoming Geoffrey's hallmark.

It first saw service in the photo reconnaissance role from Benson in September 1941 but it was not until May 1942 when well over 50 aircraft had been delivered that fighter and bomber operations started. Whilst the Mosquito's introduction was not outstandingly rapid, it was in service more quickly than the Spitfire or Hurricane and Geoffrey and George Gibbins had done their bit by completing manufacturer's trials in less than three months.

As a strategic bomber it could do as much as a Lancaster or B17 could by flying two missions to their one at a very much lower loss rate. Berlin and back before the bar closes was truly possible at least in winter. The Mosquito was equally effective attacking single building targets at low level such as the attack on the Gestapo headquarters in Oslo and the breaching of the walls of Amiens jail.

As a night fighter, it was much superior to the Beaufighter and a testimony to the Mosquito's efficiency is that it used the same type of Merlin as the Beaufighter II which was seriously underpowered in comparison with the Hercules powered Beaufighter I. Curiously, the Mosquito and the Beaufighter II shared a take-off swing which the Beaufighter I lacked. The extra performance made Junkers 88 and Messerschmitt 110 aircraft relatively easy to intercept, once they had been detected. By the end of the war, Mosquito night fighters were hunting and intercepting Messerschmitt 110's in their home airspace.

As a photo reconnaissance machine, it combined speed, high altitude capability and range and was far superior to the Blenheims it replaced.

Before long, the Mosquito's capability at low level was discovered and the fighter quickly evolved into a strike aircraft, then called a fighter-bomber. Versatility was nothing new – the Hawker Hart had been far more versatile – but the layout of the fuselage proved to be brilliant. The nose could be used for machine guns, bomb aiming or radar. The

cannon went under the cockpit floor and into the front half of the bomb bay, leaving room, if needed for two 1000 lb. bombs. Alternatively a 6 lb. (57mm) field gun extended over the full length of the bomb bay and forward under the cockpit floor.

The full bomb bay could carry four 500 lb. bombs or, when slightly bulged, one 4000 lb. 'block buster', or fuel. The only loads that could not be carried internally were a torpedo or rocket projectiles. Hard points were added early on to accommodate drop tanks, bombs or rockets under the outboard wing or a torpedo could be slung under the bomb bay.

Then a Mosquito became the first twin engined aircraft to land on an aircraft carrier, flown, of course, by Lieutenant Commander Eric Brown. The event took place on 25 March 1944, over a year before the Grumman Tigercat. The trials were successful, despite a go around following breakage of the arrestor hook and the absence, on the test aeroplane, of feathering propellers which made a single engine approach impossible, let alone a single engined go-around. Sea Mosquitos nearly became operational in the war, a task force so equipped setting off for Australia in the autumn of 1944, but the planned operation never took place.

Aerodynamically, the Mosquito hardly changed as it was developed whilst in service, the main changes being for new roles or more powerful engines. This is in contrast to the Spitfire or Messerschmitt 109 for instance where almost every component changed at one time or another.

There was, however, one significant aerodynamic change. Early in 1942, the fighter prototype W4052 was evaluated at Boscombe Down whose pilots concluded that longitudinal stability needed improvement. As a result, two sizes of tailplane were tested one of about 88 sq. ft and the other of about 98 sq. ft area. I am still trying to find out if either of these was incorporated into production.

The most significant engine change came when the two stage supercharged Merlin became available, increasing rated height from around 11,000 ft. to, initially 22,000 ft. and, eventually, to 27,500 ft. The effect was to dramatically improve ceiling and speed at high altitude, top speed increasing from around 380 mph to 410-420 mph and ceiling from around 35,000-37,000 ft. to 42,000-43,000 ft. The additional supercharger stage made the engine longer and changed the Mosquito's appearance significantly. Geoffrey made the first flight of W4050 fitted with Merlin 61 two stage engines on 20 June 1942 and on its second flight, the same day, reached 40,000 ft. Subsequent night fighter, bomber and photo reconnaissance variants all had two stage engines, the strike variants stayed with single stage supercharging.

In the spring of 1942, Geoffrey was involved in two wheels-up landings. On 19 April, he was baulked by a Proctor when approaching Hatfield in the Mosquito fighter prototype, W4052 with one propeller feathered. He was forced to abandon the landing and, since he was unable to increase power on the remaining engine, retracted flaps and undercarriage and continued to Panshanger where he landed, wheels up. Then, on 29 May, the undercarriage of another Mosquito failed to lower and another belly landing resulted, this time at Hatfield.

Production flight testing was Pat Fillingham's province. The test schedule called for three flights, lasting about fifty minutes to an hour, twenty minutes and ten minutes respectively. Then, you hoped, the aeroplane was off test. But there were rogues. The Mosquito needed to have its tailplane incidence set up just right. The manufacturing tolerances were not tight enough and an in-tolerance error one way could lead to over light stick forces whilst the other way could lead to dive instability. Ailerons could be troublesome, usually sorted out by shimming an aileron up or down, but occasionally a complete aileron would be changed, to the annoyance of Production. Rogues of this sort were usually taken over by Geoffrey or his brother John.

In 1942, Mosquito production at the de Havilland factories in Canada and Australia was starting up. In September of that year, Geoffrey was sent to Toronto to test and hand over a Mosquito that was being shipped out from England for the USAAF and to make the first flight of the first Canadian built Mosquito. Those were the ostensible objectives, but the outcome was more like a combined sales tour and rail enthusiast's holiday. A considerable effort seems to have been made to get the Mosquito adopted by the USAAF and built in the USA but, in the event, the USAAF took just

40 Canadian built machines which it used for photographic reconnaissance under the designation F-8.

His trip from Poole to Toronto combined all the worst in air travel, bad weather, lost baggage and troublesome aeroplanes. The journey, via Foynes, Botwood, Baltimore, Washington DC, Pittsburg and Buffalo ended at midnight on the ninth day when he arrived in Toronto by bus! His overall average speed was about 15mph. His luggage had made a much quicker journey to West Africa. If you've time to spare, go by air! The journey had obviously got to him; from Foynes where he was stuck for four days he wrote to his friend, Brian Cross "Oh Brian!, how ill I feel!"

Geoffrey then found that the first Canadian Mosquito had already flown and the USAAF machine had only just arrived by sea at Halifax. But, instead of giving up and going home as you or I might have done, he took the aeroplane up for a couple of test flights, accompanied by 'Pepe' Burrell and then gave two demonstrations to the works. He was, incidentally, impressed how well the machine and its Packard Merlins had been put together. That evening, he went to a party, marred for him by having to make three (very short) speeches.

The aircraft was then grounded for ten days and he decided to visit California. He went by train – Union Pacific – and described the experience as the acme of long distance travel. We can see what he meant, it only took two and a half days. In Los Angeles, he met some "pretty interesting people" including Robert E Gross, President of Lockheed, who had flown DH 4's and was a great admirer of the Mosquito.

Back at Toronto, there was another Mosquito demonstration, leading to an invitation to visit the US Navy Flight Test Centre at Anacostia and a fund raising show down the streets of Toronto below (skyscraper) roof top level at 400 indicated! Geoffrey was surprised that this did actually bring in money. Maybe Wellington's remark about his soldiers applied equally well to Geoffrey! Next came a visit to the USAAF Test Centre at Dayton, three up, with luggage, then on to Anacostia where the US Navy were allowed to borrow the Mosquito for ten days. The American pilots admired the Mosquito, particularly the ailerons, and were very critical of some of their own aircraft. One of the Navy pilots had just been flying the Mitsubishi Zero; he described it as beautifully built, good rate of climb but terribly heavy on the ailerons at the higher speeds. Then, back to Toronto by train.

There, Geoffrey met the General Manager of Boeing Canada, who was fed up with building Catalinas and wanted to build Mosquitos. Then, more local displays and off to Ottawa for a big display with the Canadian and US press well represented. Yet more people were impressed especially, as one wrote, with – "the way he kept going on one engine, doing a roll and then climbing. That's almost incredible, something I shouldn't have believed if I hadn't been there."

Then, it was Montreal to do a show for Ferry Command who were going to deliver the Canadian Mosquitos across the Atlantic. Next, back to Toronto for another demonstration and then to Washington DC to visit the US Army at Bolling Field and the Navy at Anacostia again. Whilst in Washington he was asked to demonstrate the Mosquito at Washington National Airport whose manager willingly gave Geoffrey the entire use of the field for thirty minutes, without restrictions! Geoffrey enjoyed that flight better than any other, finding the Airport ideal for shooting up.

Then he was off west again by air this time. Or so he intended. His flight reached Memphis, Tennessee before the weather closed in. So Geoffrey and his fellow passengers embarked for Dallas, Texas on the St Louis and South Western 'Cotton Belt Special', one of the World's slowest trains. Once at Dallas, things looked up and he admits to enjoying flying through the Sierra Nevadas at 10,000 ft.

At Lockheed, Geoffrey and the Lockheed pilots exchanged Mosquito and Lightning. Swede Parker of Lockheed offered the view that "de Havillands are the only people with a decent ship on this field", whilst Geoffrey reported pointedly that "As usual on American aircraft, the throttle controls and auxiliaries are excellent". Generally, though, he found the Mosquito to be superior to the Lightning but he avoided any assessment of performance. Whilst at Lockheed he was privileged to be shown the prototype Constellation, just before its first flight and was very impressed. He also showed the Mosquito to Howard Hughes who was particularly taken by the low control friction.

After a Hollywood party, it was back to

Toronto, this time on the Santa Fe 'Chief'. After spending Christmas in Toronto, there was time for a New Year's Eve party in Montreal before flying home by BOAC Liberator. This time, the delays amounted only to one day in Montreal and two at Gander. He had been away for more than three months.

At Hatfield, 1943 was notable for two events. The first was the tragic mid-air collision on 23 August 1943 between two Mosquitos which killed Geoffrey's brother John, George Gibbins, John Scrope and Nick Carter. The collision happened in cloud over St Albans; with the intensive flying in all sorts of weather and the only communication with the tower being by signal lamp, the risk of such an accident was always present.

VAMPIRE

On a much happier note, on 20 September, Geoffrey made the first flight of the DH 100 Spider Crab LZ548/G, the firm's first jet aeroplane later renamed Vampire and the World's first single engined jet fighter. The Spider Crab marked a return to an 'in house' engine, Frank Halford's H1. Halford had started work on a gas turbine design in January 1941 and the H1, later to become the de Havilland Goblin, first ran in April 1942. Its first flight was in the first prototype Gloster Meteor in March 1943. Design of the Spider Crab to Specification E6/41 got off to a slow start and initially was in the hands of the Airspeed design team who were located at that time at Salisbury Hall. The Ministry of Aircraft Production would have preferred a Hawker design, but this came to nothing and two prototype DH 100's were ordered in April 1942, just after the first run of the H1.

Wooden construction was largely abandoned for a conventional aluminium alloy structure, with the exception of the short forward fuselage which was an Albatross/Mosquito style plywood and balsa sandwich.

Geoffrey found the Spider Crab to be notably vibration free and relatively quiet. The main problems were tail strike during take-off rotation, a directional oscillation, longitudinal porpoising at high Mach number and aileron overbalance at high speed. Pat Fillingham describes the early Vampire as a very nice aeroplane to fly.

The tail strike problem was solved by realigning the booms to be more tail up. The aileron overbalance was corrected by changing the aileron section from concave to flat sided and introducing a trailing edge strip and the porpoising was eliminated by a similar strip on the elevator.

The directional problem took longer to solve and the manner of its solution is interesting. When the Spider Crab was upset by turbulence, a directional oscillation would be set up which took some time to damp out. Such oscillations are disastrous for gun aiming. The problem appeared to be excessive stability indicating excessive fin area and to demonstrate this John Wimpenny proposed a novel experiment, a forward fin. The experiment worked and the fins were then cut down to give the characteristic angular profile of the Vampire 1.

Unlike the Mosquito, the Spider Crab was inclined to tip stall and to secure a nose drop, the top lips of the intakes were sharpened. The stall was still not classic but in those days a classic stall was not thought essential, even the Mosquito with its nice clean power off stall could misbehave if stalled with power on.

Geoffrey Pike experienced the sudden tip stall on his first Spider Crab flight. When Pike expressed surprise that he had not been briefed, Geoffrey responded that he had thought it better that he found out for himself.

Being a small single seater, there was no way of carrying an observer and so the Spider Crab carried an auto-observer: a bank of cockpit instruments mounted on a panel and filmed using a wide-angle cine-camera.

Reliance was also placed upon pilot's written reports and here Geoffrey was outstanding, producing lucid, well written reports without delay. These reports recorded what he had experienced and were not analytical like those of John Derry, for instance. However, he was a frequent visitor to the Aerodynamics Department to discuss the problem of the day.

Incidentally, Geoffrey had a simple procedure for checking out a new observer. The novice would be taken up and subjected to some vigorous aerobatics, a beat up over Geoffrey's girl friend's house and some turbulence. If the candidate was still functioning normally at the end of this experience, he was OK!

Amongst pilots, something of a mystique

Vampire F1 TG370

about jets was developing and in the spring of 1944, a small group of fighter pilots, including John Cunningham, were enlisted to take part in tactical trials and give their opinions on the strategic use of jet aircraft. The first attempt was a disaster. John Cunningham remembers arriving at Tangmere to see the Spider Crab on its belly and later found Geoffrey in the bar desolated by his error.

Later, the trials were successfully carried out and Wing Commander H J Wilson, the commander of the RAE Tactical Flight reported: "The stall characteristics of the aircraft are now considered completely satisfactory. The directional stability characteristics are considered acceptable, but not ideal. The view from the cockpit and the freedom from noise and vibration inspires the pilot with great confidence and, personally, I have never flown a nicer aircraft."

Nevertheless, the Meteor was preferred on the grounds that it was a steadier gun platform and possessed a better rate of climb and higher Mach number capability than the Vampire. Although the Vampire was more manoeuvrable and had more range (not that the Vampire 1 was good in that respect), the Meteor was considered to have more development potential and twin engine safety. It may be felt that history does not support all these opinions, but there it is.

Three Vampire prototypes were built. Production was contracted to English Electric at Salmesbury and the first production aircraft TG274/G flew on 20 April 1945, too late to see war service. (The 'G' suffix to the serial number was a security tag – guard.) All but the earliest Vampires had Goblin 2 engines of 3100 lb. thrust in place of the 2700 lb. thrust Goblin 1 increasing maximum speed from 490 mph to 540 mph.

The first squadron to receive the Vampire was No 247 at Chilbolton which completed conversion from Tempests in May 1946.

During Geoffrey's lifetime there was one other Vampire development of importance. During 1945, the second prototype, LZ551/G was modified to have a longer stroke undercarriage, enlarged flaps and an arrestor hook for deck landing trials. After extended land testing, on 3 December 1945, Lieutenant Commander Eric Brown, that noted admirer of de Havilland aircraft, landed the Vampire on the Light Carrier HMS Ocean. This was the first carrier landing of a jet aircraft.

At the end of the war, de Havilland, still a very commercially minded company, quickly took advantage of export and licensing opportunities for the Vampire. The earliest customers were Sweden and Switzerland who both ordered Vampires early in 1946 and the first aircraft were being delivered by the

summer of that year by Geoffrey and John Cunningham. At £22,000 each. Vampires were a cheap way to acquire a modem air force.

The Vampire and its development, the DH 112 Venom went on to be built in large numbers (around 4000) and the Swiss Air Force only withdrew their last Vampire Trainers a few years ago when they were replaced by Hawks.

HORNET

The next new de Havilland aeroplane came close on the heels of the Vampire. Apart from the Hawker Tempest, there had been a lull in the development of new types of fighter, a situation that Geoffrey had discussed with Group Captain Ryde aboard the Santa Fe 'Chief' in December 1942. There was a lot brewing however as, early in 1943, specifications were issued for three new and very fast propeller driven fighters: F1/43 for the Supermarine Spiteful, F2/43 for the Hawker Fury and F12/43 for the de Havilland Hornet. But, whilst the Spiteful and Fury drew heavily from the Spitfire and Tempest, the Hornet was an entirely new design even though clearly related to the Mosquito. Once again, the initiative was taken by de Havilland with a private venture proposal for a twin engined fighter, manoeuvrable enough to mix it with single engined types and with long range for the Pacific war.

Geoffrey made the first flight of the prototype DH 103 Hornet RR915 on 28 July 1944. But, before that, he had found a substantial problem during taxy trials. The rudder was useless. The cause turned out to be the direction of propeller rotation: the Hornet's Merlin 130/131 engines had handed propeller drives to cancel out torque effects. The configuration had been tested in a Farnborough wind tunnel and it was found that longitudinal stability was best with the propellers rotating top outwards. The effect on the rudder was not investigated. So, before the first flight, the engines had to be swapped over and, of course, until a larger tailplane was fitted to the Hornet 3 after the war, longitudinal stability was poor.

Another repercussion of an undersized tailplane was a reluctance to flare properly before touchdown. This difficulty was resolved by removing the powerful Fowler flaps and substituting split flaps which provided the necessary drag for landing but did not give the large lift increase and nose down pitch of Fowlers.

The directional stability of the Hornet was also subject to second thoughts and although the Hornet 1 was accepted, a dorsal fairing was added to the Hornet 3 which otherwise differed from the Mk 1 only in tankage and increased all up weight.

The ailerons were different from both Mosquito and Vampire. Aerodynamic balance without the drag of a set back hinge was the objective. This time it was hoped that a convex profile would do the trick but the air always knows its business a little better than aerodynamicists and the ailerons were not right. As with the Vampire, a trailing edge strip made the ailerons acceptable, even if they were never as good as the Mosquito.

Although the engine nacelles extended beyond the trailing edge of the wing in a similar fashion to the Mosquito extensions, there was again a buffet problem. It was John Wimpenny's job to go up with Geoffrey, lying in the rear fuselage and, when the time came, slither forward and place his head in a perspex dome to observe tufts placed on the lower surface of the wing and the inside of the nacelle. A flow separation in the junction was revealed and the junction reprofiled.

Despite these problems, development proceeded at the usual brisk pace and the first production aircraft, PX210, was sent to Boscombe Down in February 1945. However, no squadron had been equipped with Hornets by the end of the war and the pace slowed down. It was not until May 1946 that 64 Squadron was equipped with Hornet 1's, the same month as the Vampire entered service.

By the time that the Hornet 1 was in service, the improved Hornet 3 had flown. As well as the tail changes already mentioned, internal tankage was increased and provision made to carry two 1000 lb. bombs or rocket projectiles on the underwing pylons.

The long range and torque free handling of the Hornet made it an obvious choice for the Navy. The first fully navalised Hornet, PX219, started carrier trials on 10 August 1945 and the first production Sea Hornet 20, which returned to the Fowler flaps of RR915, flew for the first time just over a year later.

The Hornet was all that it was intended to be. It was very fast: the prototype achieved 485

Hornet 1; pilot possibly Pat Fillingham

mph, only 5 mph slower than a Goblin 1 powered Vampire and 10 mph faster than the Meteor III. The ailerons may not have been perfect but the rate of roll was greater than that of any twin engined aeroplane of the time. As a dogfighter, it could hold its own with all but the best single engined fighters. It had tremendous range: the Hornet 3 could manage 3000 miles with drop tanks and there was a spacious cockpit with an excellent view to go with it, When I asked Pat Fillingham what he thought of spending ten hours in a Hornet cockpit, he replied that he had not done it and he did not appear to relish the idea. Pat did not think the Hornet was as good an aeroplane as the Mosquito, but fighter pilots, such as Eric Brown, still drool over it. It may not have been quite as hornet-like as the Camel but it was definitely a fighter pilot's aeroplane.

The post war RAF and FAA did not feel the need for many Hornets and production amounted to only 195 Hornets and 190 Sea Hornets.

DOVE

By the end of 1942, some minds were already turning to consider the post-war world. In the USA, civil work had not ceased; it was recognised that aircraft such as the DC 4 and Constellation had the capability of adding strategic transport to the functions that could be performed by aircraft and capacity was not as stretched as it was in Britain. Furthermore, big advances in airliner design had been in the wind in 1939 and whilst the Short S32 and Fairey FC1 had been shelved at the outbreak of war, more than two years elapsed before the USA joined in.

On 23 December 1942, the Brabazon Committee was set up to consider the post war future of British air transport. In May 1943, the committee reported, recommending the development of new aircraft in five categories. After considering a Hercules powered Flamingo development, de Havilland concentrated on two categories: Type IV which became the DH 106 Comet and Type Vb which became the DH 104 Dove.

The prototype Dove made its first flight on 25 September 1945 – six weeks after the end of the Pacific War and the twenty fifth anniversary of the de Havilland Aircraft Company. For the first time since he had become Chief Test Pilot nearly eight years previously, Geoffrey did not make the first flight but delegated it to Geoffrey Pike.

Designer in Charge of the Dove was Phil Smith who, after examining an improved Dragon Rapide capable of carrying a radio operator – back to the DH 92 – set about designing a thoroughly modern all metal monoplane with a tricycle undercarriage.

The design of the Dove included many

interesting features, most notable of which were the use of Redux metal-metal bonding and a Mosquito-like canopy. The use of four pressed sheet metal members to carry shear loads in the window area allowed very large cabin windows, a feature much admired by Mr and Mrs Beech on a visit to Hatfield. They liked the product so they (or rather their successors) bought the company! A novel feature was the use of reversible pitch propellers, pioneered on a Don several years previously. Geoffrey flew the Dove only fourteen times; he was still heavily committed to Hornet and Vampire development and demonstration.

DH 108

With the end of the war in Europe in May 1945, a race began between the British, the Americans and the Russians to discover and exploit German technology. In high speed aerodynamics, the Germans' great advance was to recognise the value of using wing sweep to increase the Mach number at which shock waves appear.

The Germans had prototypes under construction, notably the Messerschmitt P1101 but had not flown anything with more than 20 degrees sweep – the Me 262 twin jet fighter-bomber which entered service in 1944, the Me 163 rocket interceptor which entered service in the same year and the Ju 287 swept forward bomber prototype.

The former allies chose to start again from scratch and all moved fast. In Russia, MiG had the I 310 prototype of the MiG 15 flying on 30 December 1947, North American Aviation flew the XP 86 Sabre prototype on 1 October 1947. At de Havilland's, things moved even faster. Following a visit to Germany by Mr Clarkson, work started in October 1945 on the design of a tailless swept wing research aircraft to Ministry of Supply Specification E 18/45. The starting point of its design was a Messerschmitt project for a 45 degree swept back fighter, the P1111.

The company received a contract for two aircraft in December 1945. Two production Vampire fuselages, already allotted the serials TG283 and TG306 were taken from the English Electric production line at Salmesbury and fitted with 45 degree swept wings and fin. The wings of the two machines differed in detail; whereas TG283 had fixed slats ahead of the elevons and was intended for low speed work, TG306 was intended for high speed flight and had wings with Handley Page automatic slats.

Geoffrey made the first flight of the first DH 108, TG283, on 15 May 1946, 16 months ahead of the XP 86 and 17 months ahead of the I 310/MiG 15. He made nine flights from RAF Woodbridge, Suffolk before venturing onto the grass at Hatfield. Three months of intensive flying followed with one break of just under a month, exploring low speed handling down to the stall and measuring position error.

TG283 was then put aside and, on 23 August, Geoffrey returned to Woodbridge to make the first flight of the second machine, TG306, with, as I have already mentioned, a wing of slightly different design and intended for high speed flight. He made twenty flights in thirty six days extending the flight envelope to ever higher Mach number and equivalent airspeed. He also found time to display the aircraft at the first post-war SBAC display at Radlett.

The speed with which the flight envelope was expanded was quite phenomenal, and indicates that there were remarkably few problems. Nevertheless, Geoffrey was noticeably ill at ease. The explanation for this unease may lie in John Cunningham's opinion, formed during the time he flew the DH 108 after Geoffrey's death: "The 108 was incredibly efficient, wonderful if smooth. But, in turbulence, it was totally unsatisfactory due to the short period oscillation."

After Radlett, preparations started for an attack on the World Air Speed Record then held by Grp. Capt. E M Donaldson in a Meteor IV at 616 mph. What speed Geoffrey hoped to attain I do not know but Mach 0.88 seems likely, at a temperature of 20 degrees C this gives 671 mph, a speed eventually achieved two years later on 15 September 1948 when Major Richard L Johnson took the record in an F 86A. But this is idle speculation as will be seen.

Martin Sharp describes his last flight on Friday, 27 September 1946:

"His flight on Friday evening was to be his last before departing to Tangmere for attempts over the official course – between Worthing and Littlehampton on the south coast of England. The purpose was to embrace all the conditions which he might encounter. He intended to make two main tests. He was going

The prototype DH108 Swallow TG283 landing on 27th May 1946

to dive the aircraft at something under 10,000 ft at a high Mach number to check its handling and controllability. He was also going to fly level at high power near the sea to check speed and behaviour in record attempt conditions. It was a lovely evening with a slight haze and very little cloud and the air was believed to be relatively free from bumps. He said that he would do the tests, anyway the first one, over the Thames Estuary.'

'His colleagues stood on Hatfield aerodrome chatting, and then began to look at our watches as the time went by when he should have returned. Anxiety increased; then it was clear he must be down somewhere. Hugh Buckingham telephoned his father. Messages were received through Air Traffic Control to the effect that about twenty minutes after his take-off an aircraft was seen to break up in the air and fall into the Thames near Egypt Bay just north of the village of Cliffe and north-east of Gravesend.'

'Methodical searches were made by aircraft from Hatfield and elsewhere in the days that followed. Sunday was foggy. Naval helicopters alighted on the flats. Nearly all the wreckage was recovered in a few days. Geoffrey's body was found at Whitstable and was buried at Tewin next to his brother John who had been killed on August 23 1943."

So died a man who had become a popular hero. The DH 108 programme continued both at de Havilland's and at Farnborough, exploring and extending the flight envelope, measuring drag and, most significant of all in the long term, measuring wing pressure distribution. TG306 was replaced by VW120 which made its first flight in John Cunningham's hands on 24 July 1947 and the programme continued until 1950 when, within a few months of each other, both aircraft crashed fatally when operating from RAE.

Was it all worthwhile? It was a beautiful little aeroplane to look at but a beast lay within: stability was marginal at best and with its very low drag and powerful engine it was capable of penetrating well into the compressibility drag rise with the associated large and sudden changes of trim, unlike the Vampire where the aeroplane and its pilot were protected by an early drag rise due to the thick wing roots.

Nor was it seen any more as the model for the Comet. The tailless configuration had been recognised in Design as unsuitable for an airliner before the DH 108 first flew. The XP 86 and the I 310/MiG 15, designed from the outset as fighters and in less of a hurry were the bases of two first class fighters each in service within a little over two years of first flight. Even by then, in 1949, the only British jet fighters in service were the Meteor which had first flown in 1942 and the Vampire which had first flown

in the following year. The only other British swept wing aircraft to have flown by mid 1949 were the Supermarine 510 and the Hawker P1052, which like the DH 108 were swept wing conversions of existing types, and the Comet. (I have not counted the tailless designs of Armstrong Whitworth, General Aircraft or Handley Page since they all used sweepback solely on account of their tailless configuration.)

It is in this light that the true value of the DH 108 begins to emerge. It was designed as a research vehicle and as such it was a great success. In 1945 transonic wind tunnels had very small working sections and their value, not unreasonably, was questioned. There was a large high speed tunnel at Farnborough, but it was only capable of Mach 0.8. So, in de Havilland's view, the solution was to go out and try it: measure drag and stability and pressure distributions and find out what was what. The low speed characteristics of swept wings also had to be discovered and mastered and this is what TG283 was used for for nearly four years. In this country, there was no alternative.

Was the accident avoidable, perhaps by better planning or by transonic wind tunnel testing? I think probably not. A wind tunnel model for one of the tunnels at the National Physical Laboratory would have been tiny and, although Schlieren shadow photography would have revealed the unsteady shock waves that induced the oscillation, the extent of the favourable effects of going to full scale were unquantifiable. As for flight test technique, a formal investigation of damping by stick jerks could well have had the same outcome. Later in the DH 108 programme, Eric Brown (him again!) experienced the same sudden oscillation and considers that he survived because, being short, his head was better supported than Geoffrey's would have been.

It has been said that the EAP was invaluable in showing how not to design Eurofighter, similarly the DH 108 experience put paid to the idea of a 45 degree swept wing and no tailplane for the Comet.

But possibly the greatest benefit of all was that its pressure plotted wing set Hatfield on the road to scientific high speed wing design – too late for the Comet and DH 110 – but brilliantly exploited for the Trident, A300, A310, A330/340 and, perhaps finally, the Raytheon Hawker Horizon 4000 which, whatever you may hear in years to come, has a wing the high speed design of which is entirely due to two members of the old Hatfield team.

AIR RACING

From May 1946 to his death, Geoffrey was preoccupied not only with the DH 108 but also with the Vampire TG285 which was being used to develop the new tail for the Vampire 3.

But his logbook does show some relief. On 13 July, he flew the Airspeed Consul G-AHJZ from Hatfield to Deauville and, on the 16th, on to Le Touquet. I hope that it was a holiday, he deserved one. Then, on 27 August, he managed 20 minutes in the TK 2 having already done 40 minutes in TG306 and 15 minutes in TG285 that day.

On 1 September, he flew and won his last race, at Lympne, in the Vampire TG285 and I am most grateful to Des Penrose for being able to display the trophy that Geoffrey won that day and which he is to present to the Moth Club. The inscription reads:

Lympne High Speed Handicap
September 1 1946
Highest Speed over the Course
From the Clerk of the Course, GHM Miles
Won at 427 mph on DH Vampire 1 entered by the de Havilland Aircraft Co and piloted by Geoffrey de Havilland OBE

Geoffrey made twenty two more flights, all but three in TG306.

GEOFFREY THE PILOT

The story I have told so far has been more about the de Havilland company than about Geoffrey himself. I have to admit this partly reflects where my interest and knowledge lay when I started to prepare this lecture. But Geoffrey's success and fame came because he was a spearhead of the highly talented team that designed and tested de Havilland aeroplanes in the war years. Before the war, he had shared disappointments and learned with this same team. By the time that he first flew the Mosquito, if not sooner, he had become a first rate test pilot.

The stories that I have told describe only a small part of the job that he did so well. As well as the problems that the various aeroplanes presented and which I have described and, no

doubt, many more that I have never got to hear, there was the need to get the handling right. This involved changing tab gearing, trying devices such as elliptical pulleys, g weights and the like until the controls were effective, light to operate and harmonious in all conditions. It was a job at which Geoffrey excelled, getting there quickly and giving his aeroplanes a distinctive and widely admired character. Most aeroplanes did and, for that matter still do, have imperfections. Even Spitfire pilots had to put up with ailerons that were very heavy at the highest speeds.

Geoffrey was a very good communicator. Although not analytical, he described things clearly in written reports that could be relied upon to arrive promptly, probably a lot sooner than auto-observer records that had first to be developed, then read and then plotted before they were available for analysis.

He was thorough and careful and seems to have set higher standards for himself than he did for others. We have seen this in his forbearance after the Albatross mishap and again in his distress after the wheels up landing at Tangmere. But he was intolerant of people who did not measure up to his expectations. So, one novice flight observer who became very ill through no fault of his own was left in the cockpit for someone else to sort out.

His total flying time amounted to 5223 hr 5 min and he flew about eighty different types.

For his time Geoffrey's total of types flown is modest. It may seem a lot but Eric Brown who is probably the record holder, managed 487 basic types. The data that I have is incomplete but it is clear that the vast majority of Geoffrey's early experience was on single engined types. At the time that he took over the Albatross programme, his only four engined experience was the DH 86 and the highest performance the DH 88. The greatest broadening of his experience seems to have come in his early years as Chief Test Pilot, when he added Hart, Hurricane, Spitfire, Defiant, Hawk 75, Tomahawk, Lightning, DB 7, Maryland, Blenheim, Whitley and Wellington, amongst others, to his score. In 1945, he only managed three non - DH types: Albermarle, Meteor and Tempest 2 whilst, in 1946, the only strangers are a Proctor and the Danish KZ III.

He showed little interest in systems. In those days he did not really have to, since systems development was left largely to their manufacturers; the need to integrate was not strongly enough felt. Unfortunately, his disinterest applied especially to the use of radio and navigation aids where a mental block seems to have existed. Whilst in the USA, he avoided piloting ferry flights as this would have involved beam navigation and he might have 'put up a black'. This difficulty would have been an ever increasing problem in the post-war world with its rapidly increasingly dependence on control and aids and where he would have been amongst pilots who had grown up with ground controlled interception, airborne radar and an ever increasing number of navigation aids and were better prepared.

Geoffrey was also an outstanding demonstration pilot, a job which he enjoyed. His flying was accurate and he sought out the special capabilities of his mount and displayed them. An outstanding example was his single engine roll and climb with the Mosquito. There were probably earlier aircraft that could do this but Geoffrey made it his own, impressing observers with the performance and controllability of the Mosquito, as intended. He would also exploit the local topography to good effect, such as his use of the clear approaches of Washington National Airport or the streets of downtown Toronto.

In matters of safety, he was probably more concerned with the aeroplane than with himself. Test pilots were expected to take risks. Many made narrow escapes and some died, notably Kenneth Seth-Smith and Frank Furlong. At a Hollywood party, Geoffrey met an American freelance test pilot, Vance Breeze, who had given test technique and safety some thought. Breeze investigated shock stall by making a series of dives and pulling progressively more g each time. Geoffrey found this approach novel and seemed to be unsure whether it would work.

Breeze also had a somewhat bizarre scheme for spinning tests he was about to perform on a North American Mitchell. A large hydraulic jack would be attached to the control column and used to wrench the elevator down if the stick forces proved too high. He reckoned that even if the controls gave way under the strain, the control column would fall forward and thus

enable him to get clear from behind the wheel to make a jump.

It is certain that the hectic pace at which the flight envelope of TG306 was expanded will never be repeated. But, at the time, the risks were recognised and accepted. In 'Sky Fever', dH wrote: "I was always well aware of the risk element in flying, and especially in test flying, and naturally gave this a lot of thought when my sons made this their career. In the early stages we often openly discussed the risks involved, especially compared with those in a ground or office job. Neither Geoffrey nor John took these talks very seriously. They started a strange habit of refusing to call aeroplanes by their proper name. Geoffrey usually referred to them as 'boilers'. "If I take a boiler up and it blows up" he used to say, "it's just bad luck. But nothing is going to stop me."

In the end, a boiler did blow up.

But not before de Havilland's had undergone a remarkable transformation and gone much of the way towards realising a great ambition. The Mosquito, Vampire and Hornet were pre-eminent amongst combat aircraft - a domain from which the company had been excluded until 1940. The Chipmunk was about to take over from the Tiger Moth. And the utility and airliner programme being built up included the Beaver and Otter from Canada, the Drover – successor to the DH 97 – from Australia, the Ambassador from Airspeed, by now wholly owned and controlled by de Havilland and the Dove, Heron and Comet from Hatfield. Seven types covering most of the commercial market. We know now that it was all spread too thin but it was magnificent, all the same.

Geoffrey's contribution had been to ensure that the de Havilland reputation for producing pilot's aeroplanes was maintained and strengthened despite a threefold increase of speed, a threefold reduction of power loading, doubled wing loading, the appearance of Mach number as a critically important aerodynamic parameter and the jet engine. His ability to keep on top of things through a period of such great change whilst under the pressures of war and corporate ambition demonstrates clearly that his ability was quite outstanding. His services were recognised at the end of the war by the award of the OBE.

GEOFFREY THE MAN

What was Geoffrey like? Although perhaps not everybody liked him, everybody respected him for his ability. He could be biting if offered criticism or opinion that he felt to be unjustified. It is probably true to say that he put company and family before his friends and colleagues, just as his father did on occasions.

Geoffrey was, of course, not the only person of talent in his family. His father's talents were broader than his own: a pioneer and distinguished pilot, dH also designed and built a successful motor cycle and designed his first aero engine as well as aircraft. His uncle, Ivon de Havilland was designer of Iris cars from 1905 until his death in 1911. His cousins, the sisters Olivia de Havilland and Joan Fontaine, made it to the top in Hollywood. Geoffrey seems to have held his father in great respect and it is quite likely that he found it difficult to live up to his example. In dH's case, the taste for adventure and excitement was concealed behind a mask of gravitas; in Geoffrey's case it was much more apparent.

He was marred twice. His first marriage, to Gwendoline Alexander, was dissolved in 1942 and the following year he married a war widow, Pipette Marion Bruford. He met his second wife at Hatfield when she was working on engine testing. He also had the reputation of having 'a bit of an eye for the girls'.

He was appreciative of poetry and music; fond of gardens and flowers, especially cornflowers which had a private significance and which he often wore. He shared with his second wife a taste for the open country, the coast and the sea.

He was athletic, loving swimming and in his day was a good runner, winning the mile in the works sports three years in succession. without training.

He loved steam engines and railways. His report on his visit to the USA and Canada leaves no doubt of his preference for rail over air travel when not piloting.

Although, like his father, he was shy of formality, he loved parties. I have already described the infamous occasion at the 'George' in Amesbury and he seemed equally happy in Hollywood, diplomatic, business, mess or pub surroundings. He was inclined to get drunk, but his recuperative powers were excellent – he never turned up for work the worse for wear. It

was only when called upon to give a speech that his shyness prevailed.

He was a giver of nicknames. I have already mentioned 'Willy' Clarkson, there was also the 'Red Ace – John Walker, 'Pepe' Burrell and 'The Blue Cylinder', a member of the Sales Department who wore blue suits. His father was 'the Maestro'. No doubt there were more.

He had a strong sense of humour which, according to Martin Sharp, was of a sort that had been permeating the de Havilland organisation since before Geoffrey's time. When strange things happened, Geoffrey tended to get the blame, some think unfairly. One morning, a Green Line coach was found in the middle of the airfield. Some time later, Geoffrey was aloft, checking the legibility of a new message board for pilots. The last message was "who moved the bus?" and it is said that Geoffrey was a bit flustered when he landed.

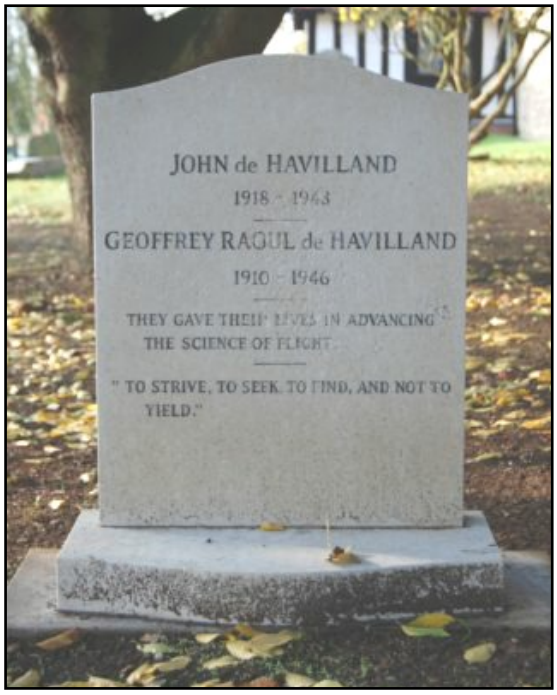
Geoffrey Raoul de Havilland lived for flying; it was his living and his pleasure, just as it was for his father. He was an outstanding test pilot and demonstration pilot, admirably filling the needs of the commercially and technologically ambitious de Havilland company.

Professionally and personally Geoffrey was not faultless and he would have found the post war flying environment very hard. But, in his time, his talent and skill overwhelmed his weaknesses and there can be no finer epitaph than Martin Sharp's: "In an age that gives approval to mediocrity, nothing was ever mediocre about Geoffrey."

Footnote: towards the end of his lecture David referred to two memorials to Geoffrey: his grave at Tewin and the plaque in the main entrance hall of the Administration building at Hatfield, expressing the hope that the latter "is recorded in the building's Listing and is reasonably safe."

The de Havilland gravestones at Tewin had deteriorated badly and were replaced with new ones re-dedicated in January 1998. The Admin building is now the Hatfield Police Station and the plaque is indeed preserved; the photograph below right was taken in 2017.

Roger de Mercado



ADDENDUM

Geoffrey was honoured after his death in a number of ways. In June 1947 the internal Company publication 'DH News' recorded that he had been post-humously awarded the Gold Medal of the Royal Aero Club and the Segrave Trophy - see opposite.

In August 1948 the Geoffrey de Havilland Trophy, a new cup for British air racing, was handed over to the Royal Aero Club by Mr. P W Grigsby acting on behalf of the de Havilland experimental departments - see below, from 'DH News' August 1948. The cup was awarded until at least 1991. It is no longer listed amongst the Club's trophies.

Roger de Mercado

THOSE who were close to Geoffrey de Havilland will have learned with appreciation of two post-humous distinctions which have been awarded to him. They are the Gold Medal of the Royal Aero Club and the Segrave Trophy. Geoffrey himself would have seen these awards as recognition of the team of technicians and pilots of which he was such an outstanding member.

The Royal Aero Club has made a special commemorative award of the Gold Medal to mark his " distinguished services to aviation as a test pilot." Only 23 Gold Medals have been issued, and the only previous posthumous award was made in 1910 to Cecil Grace, who lost his life while flying the Channel. Wilbur and Orville Wright won the first award in 1908. Other recipients include Louis Blériot, C. S. Rolls, Henri Farman, Sir John Alcock and Sir Charles Whitten-Brown, and Sir Alan Cobham, and the last award was made to Miss Jean Batten in 1937. It is a prize to be valued highly.

Geoffrey de Havilland has also received the first posthumous award of the Segrave Trophy, given annually for " the most meritorious performance on land, sea or in the air." The current award of the Trophy, which has in the past been given to Sir Charles Kingsford Smith and Sir Malcolm Campbell, amongst others, recognises, in particular, Geoffrey's achievement in flying the DH 108 at high speed, including true level speeds considerably greater than any so far attained.

THE GEOFFREY DE HAVILLAND TROPHY

A new cup for British air racing presented by Geoffrey's friends in the Experimental Departments.

Percy Grigsby takes an apprehensive grip on the microphone after handing over the Geoffrey de Havilland Trophy to Sir Francis McClean, A.F.C. during the prize-giving ceremony at Lympne.

AT THE LYMPNE RACE MEETING on Saturday, August 28, which is organised by the Cinque Ports Flying Club, the Geoffrey de Havilland Trophy, for the best time achieved in the race, was handed to Sir Francis McClean, A.F.C., representing the Royal Aero Club, by Mr. P. W. Grigsby, B.E.M., acting on behalf of the de Havilland experimental departments. As reported in this issue, the first winner is Geoffrey's successor, John Cunningham. As in 1947, the Hythe Trophy was awarded to the winner of the race, which was a handicap.

The new cup has been presented by colleagues of the late Geoffrey de Havilland in the experimental departments of the de Havilland Enterprise, people who worked with him through the eventful years when he was chief test pilot of the Company which his father founded.

Many de Havilland employees contributed to the Geoffrey de Havilland Memorial Scholarship, which is administered by the Royal Aeronautical Society, but those who were closest to Geoffrey in his experimental flight duties offered this trophy because they felt that they would like particularly to keep his memory alive in the field of air racing which always meant so much to him. The cup bears a medallion with a bas relief profile of the head of Geoffrey de Havilland, executed by Eric Kennington, and each winner will be given a replica of this in the form of a silver medal.

The Racing Committee of the Royal Aero Club will each year decide for which race the trophy shall be awarded, the intention being that it should be for the principal British high-speed race of the year.

DHT's ACKNOWLEDGEMENTS

Sky Fever	Sir Geoffrey de Havilland	Airlife, 1979
DH	C Martin Sharp	Faber & Faber, 1960
De Havilland Aircraft	A J Jackson	Putnam, 1962
British Aviation, 1903-1914	Harald Penrose	Putnam. 1967
British Aviation, 1915-1919	Harald Penrose	Putnam, 1969
British Aviation, 1930-1934	Harald Penrose	HMSO. 1979
British Aviation 1935-1939	Harald Penrose	HMSO,1980
Mosquito	Philip Birtles	Janes, 1980
The Mosquito 50 Years On	Ralph Hare & others	GMS Enterprises, 1991
De Havilland Vampire	David Watkins	Sutton, 1996
Flight Testing DH 108 Research A/c	John Wilson	Unpublished, 1996
British Flight Testing	Tim Mason	Putnam, 1993
The British Fighter	Francis K Mason	Putnam, 1992
British Aeronautical Research Facilities	W F Hilton	JRAeS January 1966
Test Pilots	Don Middleton	Collins, 1985
Test Flight	Geoffrey de Havilland Jr	De Havilland Gazette 1938?
Geoffrey de Havilland	Anon	De Havilland Gazette October 1946
Geoffreyde Havilland	Henry Matthews	HPM Publications, 1996
Geoffrey de Havilland 1882-1965	R M Clarkson	JRAeS, February 1967
The DH 88 Comet Racer Recollections		R M Clarkson Unpublished, 1987
The Dove and its Developments	J P Smith	Unpublished, 1991

Conversations	S C Caliendi
Conversations	R E Clear
Conversations	J Cunningham
Conversations and correspondence	B Ewens
Conversations and correspondence	W P I Fillingham
Conversation	P Marsom
Conversations and correspondence	R E C de Mercado
Conversations and correspondence	D R Newman
Conversation	B N J Scull
Conversations	J C Wimpenny