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Sopwith Camel and Eurofighter Typhoon, Modern Air Combat Fighters of their day

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The title had an incongruous ring, but the very clear opening message was that this lecture was not a one-on-one comparison. The immediate pronouncement was to assure the audience that there are similarities in the sense of trends in power/thrust-to-weight and wing-loading of the past have not changed in almost a century of military aircraft evolution.

The Sopwith Camel, was designed in 1916, first flown on 22 December 1916, and was in service with the Royal Flying Corps in January 1917. Amongst its contemporaries it was a relatively conventional aircraft, but it was also a very successful design – for a while - in terms of its ability to outpace its adversaries in World War 1. The success was short-lived because it was flawed in terms of handling qualities, and this earned it a far from pleasant reputation and although its career at the front-line was brief, this did not prevent over 5,000 examples being built. Although retired entirely by 1920 the type's legacy was subsequently reinforced as in the media as it was the favoured aircraft used by 'Biggles,' and it was central too to the antics of cartoon dog and aviator ace 'Snoopy.'

The 'hump' on the Sopwith Camel that neatly integrated the gun controls into the cockpit.

The 'Camel' is believed to have been so named because of the unique fairing above the fuselage mounted armaments – two Vickers synchronised machine guns – which were ahead of the cockpit. The fairing created a 'hump' appearance when viewed from the side.

It was a relatively small, and compact design, and fared well in combat overall, but was also plagued with a reputation for being a very difficult aircraft to fly. The largest contributor was the Clerget rotary engine, which was used extensively in early aircraft (some models had a similar Bentley rotary engine). Because the engine rotates with the propeller, thereby creating a cooling airflow around the cylinders at all speeds, there is a spinning mass at the aircraft's nose at all times. A rotary engine was attached to the fuselage and had to rotate freely, and it required continuous lubrication. The preferred lubricant was castor oil and this was not the choice of any pilot who sat in its wake, as the oil has long been a recognised remedy for constipation.

The 130hp Clerget engine – 350lb (160kgs) – and propeller – 40lb (18kgs) – rotated at 1,250 rpm: and as this was a substantial proportion of the aircraft's total weight (25% at maximum weight and up to 40% on take-off at maximum weight) the precession (or gyroscopic) impact on handling qualities was substantial. This offset the aircraft's high power:weight ratio, which was fundamental to its agility in combat, as rapid control inputs in either roll, pitch or yaw would cause a considerable additional attitude change at 90 degrees to the plane of input. Hence, although the aircraft could turn through 360° in 8-10 seconds, on applying an aileron input to turn left the aircraft would also pitch nose-up: and when turning right it would pitch nose-down. It was the severity of this characteristic, especially when turning to the right, which had to be learned and counteracted by appropriate pilot control inputs to attain the path desired, but this fundamentally good combat performance as the aircraft was now capable of out-manoeuvring almost any adversary. Prompt control responses – anticipated by a pilot with experience - would prevent a severe divergence, and this was vital when turning right to prevent the aircraft entering a spin. Even when looping (pitch control input) the aircraft would slip sideways (yaw to one side). This could make it look ungainly in display, but these were characteristics that led to the most proficient pilots being able to use such unconventional manoeuvring to outwit a pursuer. Losing control was what led to much attrition, especially amongst relatively fresh pilots, but once a pilot was proficient they could expect to attain high kill success statistics.

Rotary engine or not, the somewhat diminutive aeroplane had a much smaller moment of inertia than its contemporaries too. This was due to the proximity of engine, armament cockpit and fuel tank, all positioned within a very short section of the fuselage. The arrangement of the lifting surfaces also led to the centre of gravity (CG) being further aft than one would expect, indeed making the aircraft potentially 'unstable' – meaning that the 'stick force per G' would reduce and reach zero when the CG it at the 'neutral point.' The aircraft would not respond intuitively if the CG were further aft, and the consequences were catastrophic. (This was not precisely predictable in WW1 – the theory was to evolve in the late-1920s). Designers knew of the phenomenon and judged – based in test pilot reports – where to set the most aft CG position, and on the Camel it was clearly set close to the limiting condition. The speaker spoke of analysis suggesting the typical CG position was indeed further aft than one might have expected it to be.

This model of a Sopwith Camel shows the proximity of (from front to back) of engine, armament, cockpit and fuel tank – all are in the forward part of the fuselage.

The set-back of having to use a single-seat aircraft with difficult handling characteristics to train a pilot who is new to the type.

It has to be no surprise, to recall that training accidents were more commonplace with the Sopwith Camel that in other contemporary types, but this had to be expected and the training regime took on the issue of preparing novice pilot for the quirkiness of this type. An oft quoted possibility is that, as turning right was more dangerous for a new pilot than turning left, the new pilots were encouraged to fly 'left-hand' circuits, a convention applied wherever possible even to the current day.

Due care of this nature moderated training losses – of aircraft and airmen – accordingly, but a sad legacy has been that pictures of mangled and forlorn Camel airframes abound in historical archives.

Looking at the modern-day scene, the speaker commented how the Camel was an aircraft that had lower wing-loading (aircraft weight/wing area) and a higher power:weight ratio than counterpart designs. It was this combination, with a skilled pilot at the controls, that at its introduction contributed to its success in air-to-air battles. However, this was a time when a new design could leave the drawing board and be in service a matter of weeks later: the next generation aircraft were coming along and within a year or so the Camel was easier for the enemy to out-fly, and it fell to newer designs – bigger wings perhaps, large engines almost certainly – to replace it in front-line squadrons.

At the present time new-generation designs come along almost once in an engineer's career. They are vastly more complex and expensive, but the speaker emphasised that the role briefly held by the Camel has been handed-down to the Eurofighter Typhoon, and that it too is an aircraft that has the same combination of lower wing-loading and higher thrust/weight ratio than stable-mates and counterparts. The technology in the recent generation aircraft is nowhere near so rudimentary. Especially 'fly-by-wire' flight controls nowadays harmonise the control forces through all axes and allow the aircraft to fly with a CG so close to the critical 'neutral point' (in some cases it might even be aft of that once un-crossable datum) to keep the aircraft stable and for the aircraft responses to be in harmony with the pilot's control inputs. With a low wing-loading and a high thrust-weight ratio, the aircraft can be manoeuvred with exceptional agility, and the concept used is often referred to as 'carefree.'

A concluding comparison was that the cost of aircraft has risen accordingly too!

The presentation was a novel way of looking through the annual from 100 years ago and reconciling modern-day technology with the simpler, and often riskier, technologies of the past. The message that manoeuvrable aircraft need as low a wing-loading as possible and as high a thrust/weight ratio as possible might not be the full story, but it was very appropriate, and worthy of being given such prominence. The presentation was attended by a 140-strong audience who expressed their pleasure at being given such a comprehensive report as a fitting and enjoyable final visiting lecture in the current Branch programme.

Lecture notes by Mike Hirst