Flying Early Aircraft – Flying Qualities in the Early Years
Roger 'Dodge' Bailey, Shuttleworth Collection Chief Pilot
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The speaker, a qualified test pilot well-known through over 20 years of experience at the Shuttleworth Collection, addressed two rarely conjoined perspectives: the flying qualities of early aircraft which make them quite different to fly (to modern pilots), and the legacy from the study of their maladies which has ensured more acceptable flight qualities of modern aircraft.

The approach he used melded technical and practical knowledge in a manner that conveyed knowledge, passion and caution. His examples were based around his experience with the aircraft at Old Warden, and he concentrated on aircraft that flew before the end of WW1. A selection of aircraft was shown on video: and, had he not enlightened everyone to the control issues involved, the uninitiated would have failed to recognise what flying skill was being exhibited in some relatively unassuming manoeuvres. The videos featured Bleriot, Roe Triplane, Bristol Boxkite, Deperdussin, Blackburn Monoplane, RAF BE2e, Avro 504K, Sopwith Pup and Snipe, SE5a, Bristol Scout and Fighter, and Albatross (see table at end for descriptions).

First, he summarised that most aircraft of this era were underpowered. Secondly, he described their handling. In terms of pitch response he said they were mostly unstable, but relieved the anxieties of some pilots present by stating that the pitch response was, in most cases, similar to 'modern' aircraft. Finally, referring to roll/yaw axis responses he was equally honest: cautioning that lateral/directional characteristics can differ so significantly from current-day designs that 'modern' pilot techniques will too often lead to loss of control. This was largely due to so little having been known about stability and control, and he believed this was often because there was an over-reliance on the infusion of nautical legacy.

He avoided the academic approach to describing 'derivatives' – mathematical expressions that link control and effect properties - in two ways. To set the scene, he cited examples of modern design legislation that demand essential properties of a modern aircraft, e.g.: it must have a stable stick force curve (more prosaic: the aircraft will not stall unless the pilot's stick inputs command it), and an aircraft should be flyable (capable of being landed) following the failure of a single control circuit. He observed that since criteria such as these were introduced (and these are two major requirements amongst many that were uncited), the principle flying skills of modern pilots have become transferrable across all types. It has made aviation a safer pursuit.

He introduced the three major inputs from flight controls, and eight primary effects of controls, to illustrate how scientists applied simple analytical processes that associate control inputs to appropriate stability and control effects. The appropriate combinations of these were then used to dissect the reasons for some poor handling qualities that he described in detail, and the handling palliatives that he could justify. These notes are brief and do not detail his examples (as they are very aircraft dependent and not panacea solutions that anyone should regard as generally applicable).

An important step was to address how some control inputs that induce a change in the aircraft's attitude in an design with little or neutral stability can require pilot reaction in other (non-intuitive) axes – sometimes regarded as 'secondary effects.' In modern aircraft these are minimised in generally simple ways: e.g.: by having a dihedral angle on wings (from the front - the tip is higher than the root), using reasonably sized stabilising surfaces, and taking appropriate caution

Control deflections	Primary Effects		
elevator	**Angle of attack**	**Pitch rate**	**Pitching moment**
aileron	**Nil**	**Roll rate**	**Rolling moment**
rudder	**Sideslip angle**	**Yaw rate**	**Yawing moment**

regarding the positioning of propellers. His descriptions of types he flies illustrated how principles that can be assessed by knowledgeable pilots can forewarn them of where (in the flight envelope) - and why – handling deficiencies can be anticipated.

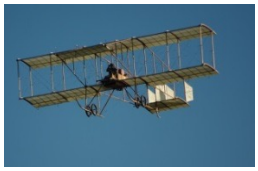
His general cautions need to be understood. He stressed that we have the knowledge to live with them, but still need to be cautious, but reflecting on the early days of aviation he lamented how training pilots to fly in the era of these aircraft types was a difficult task. A specific point was the widespread use of rotary engines in early aircraft. As the whole engine carcase revolved with the propeller it created gyroscopic precession effects, and in a steep turn to the left the necessary left rudder deflection would seem relatively normal to a modern pilot, but a steep turn the right is very different. Rolling quickly into a steep right turn requires the rudder to move initially to the right (countering adverse yaw on entry) then very quickly to the left as nose-up pitch rate increases. Failure to do this in aircraft which also have small dihedral and small (if any) fin area, and low longitudinal stability, can result in a spin to the right. He commented that "this goes some way to explaining the very high accident rate suffered during Sopwith Camel training" and added "it could have been the reason why in training it was customary to teach flying with a left-hand rather than a right-hand circuit."

He included a set of slides that showed the procedures used to start and run a rotary engine too: and it showed this was more than just having a starter button (the engine control settings need to be carefully coordinated, and magneto and prop-swing procedures followed) and there was the 'blip switch.' The latter is a major source of concern to those who hear a rotary engine without warning, as the whole ignition system is stopped and started on demand. This can make taxiing, and even and approach to landing, needing careful judgement, and causes sudden changes in engine and propeller noise.

This presentation was attended by a 160-strong audience that absorbed a great deal of information. It was presented in an almost seamless fashion, and at question and answer time the areas further probed received welcome additional support. This member of the audience feels justified to summarise it as a presentation that set out to reconcile 'the good, the bad and the ugly.' But that does not mean to say that it was a spaghetti western: in describing a disparity of issues, revealing how they are reconciled, and what great legacies we would be foolish to take for granted, it was a reminder of history we can cherish.

Lecture notes by Mike Hirst

Some of the aircraft – illustrated and described in brief

Aircraft	Wing span ft (m)	Wing area ft^2 (m^2)	Empty wt lb (kgs)	Engine	Max Speed (mph) kt	Configuration
Bleriot XI (1909)	25.58ft (7.79m)	250 ft^2 (24m^2)	507lb (230kg)	Anzani 3-cyl 25hp	47mph (41kt)	
Roe Triplane (1910)	20.00ft (6.1m)	320ft^2 (30m^2)	300lb (136kg)	JAP 9hp	25mph (22kt)	
Bristol Boxkite (1910)	46.5ft (14.6m)	517ft^2 (48m^2)	900lb (408kg)	Gnome rotary 50hp	40mph (35kt)	
Deperdussin (1911)	28.75ft (8.76m)	150 ft^2 (14 m^2)	617lb (280kg)	Anzani 3-cyl, 50 hp	58mph (49kt)	
Blackburn Monoplane (1912)	31.1ft (9.78m)	236ft^2 (21.9m^2)	550lb (250kg)	Gnome 7-cyl 50hp	60mph (52kt)	
Roy.Acft.Fac BE2e (1915-17)	37.0ft (11.38m)	371ft^2 (34.8m^2)	1370lb (623kg)	RAF 1a V-8 90hp	72mph (63kt)	
Roy.Acft.Fac SE5a (1916)	26.6ft (8.11m)	244ft^2 (22.7m^2)	1410lb (639kg)	Viper V-8 200hp	138mph (120kt)	
Sopwith Snipe (1918)	31.1ft (9.48m)	271ft^2 (25.2m^2)	1312lb (596kg)	BR2 Rotary 230hp	121mph (105kt)	

Sopwith Pup (1916)	**26.5ft (8.08m)**	**254ft^2 (23.6m^2)**	**787lb (358kg)**	**LeRhone Rotary 80hp**	**111mph (97kt)**	

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