What was the Camel like to Spin?

by Philip Jarrett, Honorary Companion, RAeS

Sopwith F.1 Camel B2312 was used in both of the series of experiments at RAE Farnborough described here. It was from the first production batch for the War Office, built by Ruston, Proctor at Lincoln and comprising 250 Camels. Initially tested at Martlesham Heath, during its life it had various Clerget engines installed and also a Bentley A.R.2. :Royal Aircraft Establishment Negative No.3549

Having read Colin Owers's article 'What was the Camel Like to Fly?' in the summer 2024 issue of the *Cross & Cockade International Journal*,[1] it seemed to me that one particularly significant aspect of the subject was conspicuous by its almost complete absence. This aspect was the Sopwith Camel's behaviour in a spin, which I felt was especially relevant in the case of this twitchily unstable machine. Darrol Stinton, in his book *The Anatomy of the Aeroplane*, succinctly describes spinning as *rotation of the aeroplane about its axes when the lifting surfaces are stalled asymmetrically*[2]. This rather mild-sounding description belies the Camel's behaviour in this circumstance. In another of his books, *Flying Qualities and Flight Testing of the Aeroplane*, Stinton, a very experienced test pilot who flew a replica with a Clerget engine, says the aircraft *epitomised agility*, and neatly summarises the instability that made the Camel such a demanding machine to fly:

The aeroplane had no stability to speak of about any axis. It was all control. Blink, and it was away in another direction, with instant response to the smallest movement of any control to bring it back again. It could be pointed and side-slipped with ease in any required direction — what was needed of a gun platform by a scout pilot.

At high speed it was longitudinally and directionally skittish. … Turning to the right the Camel whipped round like a dog chasing its tail, appearing to accomplish this in a diameter little more than its own length. Gyroscopic precession caused the nose to drop, and a conscious touch of elevator was needed to level the turn. Turning left, all was balanced and sedate. The tail was docile; with spin recovery in less than a quarter turn, left and right.[3]

One particularly informative first-hand account of the Camel's handling is the article by Capt Norman Macmillan entitled 'Power to Manoeuvre', which was published in *Shell Aviation News* No.419 in 1973. Macmillan says that his first unnerving flight in a Camel … *taught me early on that the Camel was the fastest manoeuvring aeroplane in the sky and as such had to be mastered, not messed about.* He recalls an occasion when he was aloft with a pupil in an Avro 504 at 1,000ft when he saw a pilot in a Camel practising live shooting at a ground target:

There was a gusty wind and the air was turbulent. I watched my Camel diver, saw him overdo the 90-degree roll and rudder method I had taught all my pupils as the way to dive a Camel safely, then flick over on his back. An instant later he began to spin inverted. He took immediate recovery action as instructed, recovered, but again stalled because he tried to pull out too soon.

His Camel flicked into a right-hand spin. Again, he tried to pull out too soon, stalled once more, and flicked into a left-hand spin. From this he also recovered quickly. He allowed time to gain speed, even at the loss of height now so near the ground. While I watched I saw the Camel answer his control movements and begin to round out because he kept his head, and at the third time he did what he had been told to do — give his Camel time to gather speed after a stall.

I saw him hold the dive long enough to gain safe speed, but perilously near the ground. In the final round-out his wheels actually touched the surface. I saw them kick up a little dust cloud as they did so. He opened up his Clerget engine and I saw him climb up into the beneficent air. It was a close shave. Only the Camel could have spun about three different axes in a thousand feet and come out unscathed.

Later, when spinning accidents began to receive special attention during 1918, the Camel was found to be the worst offender. There were 27 Camel fatal spinning accidents in May 1918, 14 more just outside that month. Nineteen were from 500ft or less; 22 from height; seven were double spins, usually in reverse directions. Nowhere have I ever traced a triple spin such as the one I actually witnessed and from which my pupil survived.

Spinning investigations showed that with engine shut off the aircraft's periodicity was 1½ to 2 seconds, with a height loss of 150 to 200ft for each complete turn. From tests I found that with the engine running I could complete ten turns in 1,000ft, one turn for 100ft loss of height. With engine on, downward speed was affected less than rotational, and faster rotation was caused by the combined effects of engine torque and slipstream on the tail. But it was sickening to spin so rapidly. I made the tests in order to be able to teach pupils how to overcome snags that might arise *in emergencies during their Camel flying.*[4]

Macmillan's own period handling notes for the Camel, entitled 'A Fierce Little Beast', were published in *Aeroplane Monthly* in 1984. In the section on spinning, he writes:

The Camel spins fairly quickly. The easiest way to commence a spin, both for pilot and machine, is to go in off a climbing turn by bringing the stick back slowly as the nose tends to drop. In the spin … the Camel has a constant dropping speed provided the stick is fully back.

To spin to the right, stick full back to the right, and about half right rudder. To come out stick very slightly forward of neutral and centralise rudder. The Camel comes out of a right spin in less than half a turn. Then allow time to gather flying speed.

To spin to the left, stick full back to the left and about half left rudder. Come out in the same manner as for a right spin. The Camel is little more sluggish in coming out of a left spin.[5]

Although extracts from the article 'Flying the Camel in 1918', by Ronald Sykes, published in the 2 May 1968 issue of *Flight International*, are quoted in Owers's article, he omits Sykes's description of entry and recovery from the spin in a 150-hp Bentley-engined F.1 Camel, which reads:

Pull up into a stall and apply the usual encouragement from the rudder; the Camel will then cartwheel over and then flick into a spin (which, with the stick held right back, will be fast one). Centralise the controls and after about four more turns the machine will come out of the spin; it can be forced out more quickly by applying opposite rudder and pushing the stick forward briskly, though this does not always have the desired result.[6]

Official Tests

Some years ago, I acquired a small collection of fortnightly reports issued by the Controller, Technical Department — Aircraft Production, in the Ministry of Munitions, in the latter months of 1918. It contains a couple of reports relating to trials undertaken by test pilots at the Royal Aircraft Establishment (RAE), Farnborough, to investigate the behaviour of the Sopwith Camel in a spin.

The 63rd report, for the fortnight ending 18 September 1918, includes an account of comparative spinning trials of Clerget-engined F.1 Camel B2312 and Royal Aircraft Factory SE5a B600. Measurements were made of the period of longitudinal oscillation of the SE5a, *which is stable*, and measurements with a recording air speed indicator of the action of the Camel, *which is unstable*. In both instances records are presented of the respective aeroplane's airspeed against time.[7]

The report states: *The force on the stick of the Camel, both gliding and with engine all out, has been measured and it is seen from the results that the aeroplane with the standard tail setting is always tail heavy, and is badly tail heavy with the engine on near the ground.*

Thus, it is seen that the Camel is unstable and badly out of trim and is continually trying to stall itself, which shows that it will often be in a condition when it is liable to spin.

As regards the actual spinning, the S.E.5a and the Camel spin at almost exactly the same rate, though the Camel does not lose height quite so quickly owing to its lighter loading. The Camel did not spin smoothly to the right, but went round in a series of jerks, whilst the acceleration appeared to have a rapid variation on each turn, and reached a maximum as high as 3.5g.

Comparative graphs and tables were presented, and these are reproduced on the following page.

Figure 1 shows the longitudinal period of SE5a B600 with the engine off and the elevator fixed. In Figure 2 the phugoid oscillations of B600 are depicted, comparing the behaviour with the tail central and the tail full back, and it can be seen that in both instances these oscillations diminish as the aircraft's inherent stability dampens them out.

Figure 3 presents the control forces in pounds on Camel B2312, at various speeds with the engine off and on, and Figure 4 shows the unstable behaviour of the Camel, with the phugoid oscillations rapidly and violently increasing.

Finally, three separate tables (see following page) provide performance figures. In Table I comparative longitudinal periods of the SE5a with its elevators fixed and the engine off, with the tail full back, and with the tail centred, are presented. Table II compares the results of the spinning tests of both aircraft with their engines off. The significantly faster turn time of the Camel is noteworthy. Table III presents the results of control forces on the Camel with the engine off and

Vickers-built Royal Aircraft Factory SE5a B607 was from the same 200-aircraft production batch as B600, which was used alongside Camel B2312 for the first RAE spinning trials. While B600 spent all of its life on experimental work at the RAE, B607 served with the Wireless Experimental Establishment at Biggin Hill, marked with the number1. :author's collection

All of the views of B2312 shown below and next page were taken at the RAE on 3 October 1918, when it had a Clerget rotary engine. As well as being used for the spinning tests, it was also used for other RAE trials. :Royal Aircraft Establishment Negative Nos. 3552 and 3550

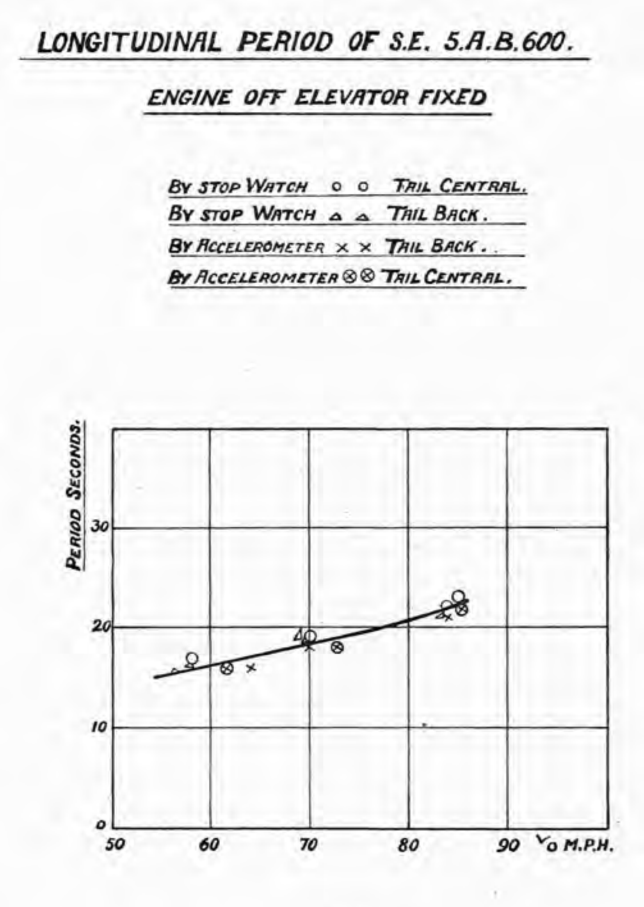


FIG 1.

on at indicated speeds ranging from 50 to 100 m.p.h., at two different altitudes in each case, with the normal tail setting without elastic assistance.

Further Experiments

The 64th report, covering the fortnight ending 2 October 1918, includes an item entitled 'The Behaviour of a Sopwith Camel in a Spin'[8]. It states experiments were carried out at the RAE to investigate the behaviour of the Camel when spinning, and the effect of different motions of the controls in bringing the aeroplane out of the spin.

Two Camels were used for the experiments: the aforementioned F.1 B2312, *a standard aeroplane with a Clerget rotary engine*, and F.1 D1965 with a Bentley BR.1 rotary engine and weights placed in it to obtain the same position of the centre of gravity (c.g.) and the same total weight as B2312.

As observed previously, it was found that the Camel … *spins smoothly to the left but in a series of jerks to the right, the period in each case being about two seconds*. It was impossible to bring it out of a spin with the control column back, and when coming out of a left-hand spin with right rudder the aeroplane tried violently to start a spin in the opposite direction.

The first set of experiments consisted of a number of timed spins to determine the rate of rotation, and the height drop. The results are given in Table IV, and the mean values were:-

	SPIN TO LEFT		SPIN TO RIGHT	
	time	height drop	time	height drop
D1965	1.9 sec	130ft	2.1 sec	200ft
B2312	1.8 sec	-	2.05 sec	-

In the right-hand spins of experiment No.2 the pilot *noted that the aeroplane spun badly, going round in jerks and trying to come out all the time*. The left-hand spins were *perfectly smooth*. Again, in experiment No.5, the pilot noted that the first five turns of the right-hand spins were in jerks, but the later turns were normal.

It was concluded that the Camel spun steadily to the left, but in an *uncertain manner* to the right, and that in these right-hand spins the period of rotation and the vertical velocity were both greater than for the left-hand spins.

A second series of experiments were then carried out to *investigate the case of coming out of the spin with different positions of the controls*. During these experiments an airspeed accelerometer was carried, and the recordings were used to obtain the maximum speed and acceleration reached when coming out of the spin. It was found to be impossible to come out of either a right-hand or left-hand spin by movement of the rudder alone with the control column fully back. This showed that, when the spin had once started, the rudder was ineffective to stop the rotation. The best method of coming

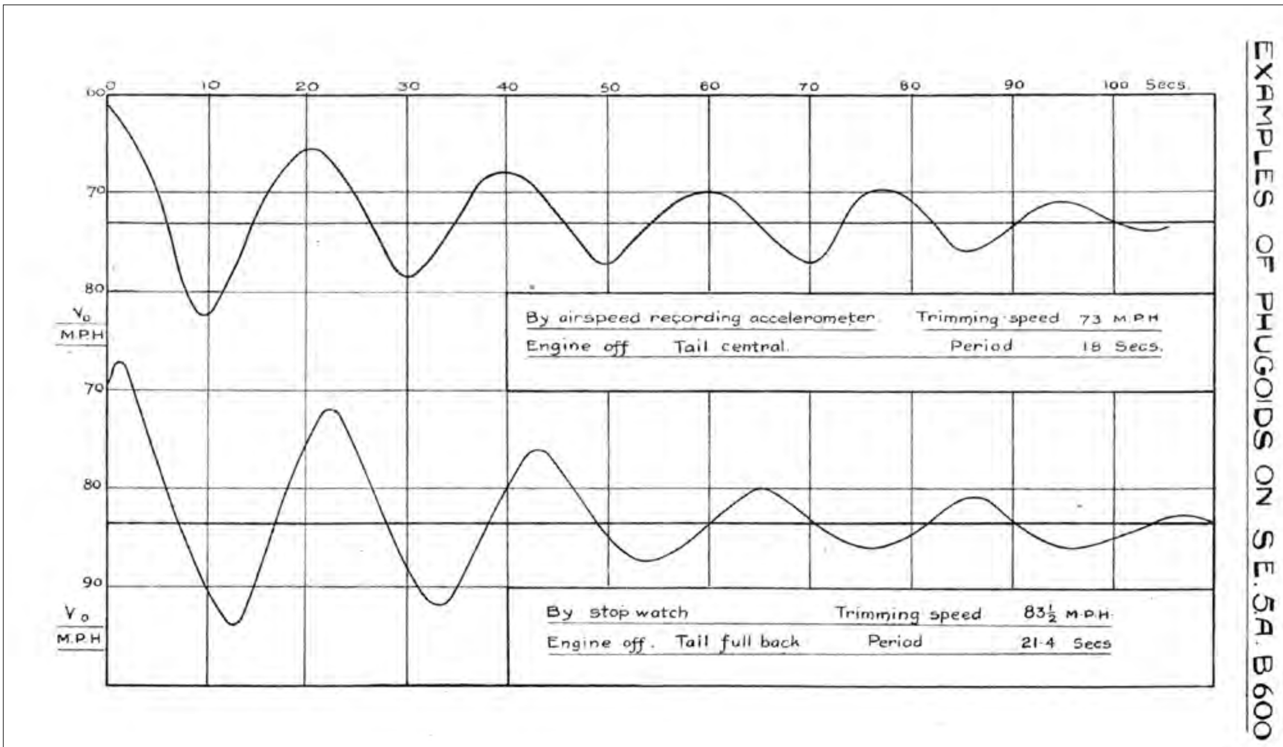
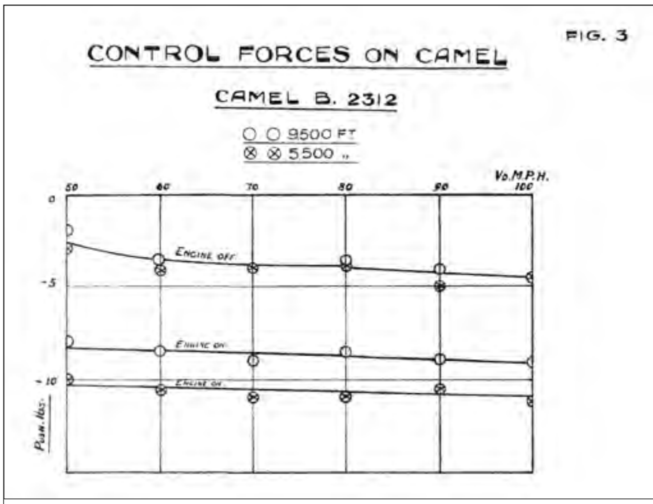


FIG. 2



out of a spin appeared to be with the control column forward and opposite rudder. The time required was 3 seconds and the height required was 350ft. Acceleration reached 3g.

The report commented: *These results must be contrasted with similar tests on an S.E.5a*. The best position for the controls on this aircraft was with the control column back and opposite rudder. The height drop was then 600ft and the acceleration about the same as that for the Camel.

When coming out of a left-hand spin the Camel tended to start a spin in the opposite direction. This occurred in experiments 6, 8 and 9 (see Table V), and the height drop was consequently *considerable*. In the last experiment (9), the pilot noted that the aeroplane started spinning to the right at an early stage, and that the change-over was *very violent*. This second spin occurred if the rudder was put across instead of being held central, but did not occur when the rudder was held central.

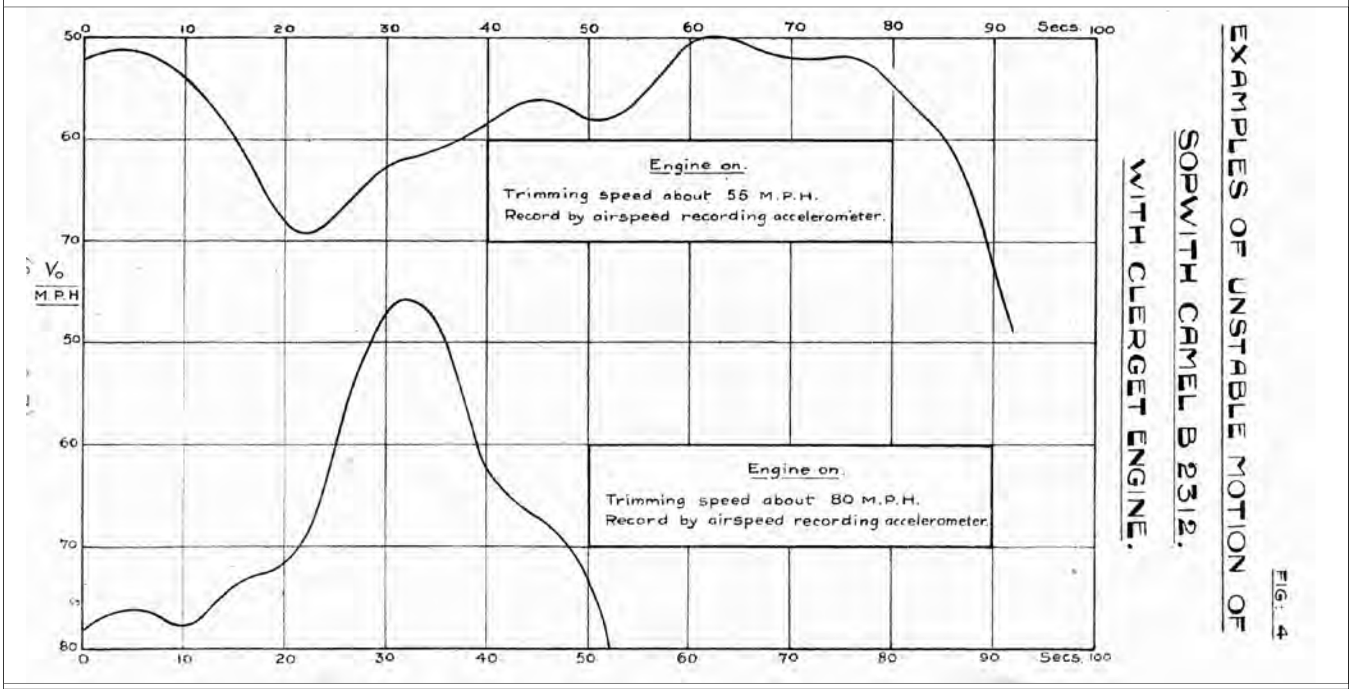


TABLE I.

Longitudinal Periods of S.E.5a, B.600.

Elevators fixed ; engine switched off.

	By stop watch.		By accelerometer.	
	Airspeed m.p.h.	Period secs.	Airspeed m.p.h.	Period secs.
Tail full back.				
	56½	15.5		
	58	16.5		
	69	19.2	64	16
	69½	19.1	70	18
	83½	21.4	84	21
Tail central.				
	57	14.0	61½	16
	58	16.7	73	18
	70	19.2		
	84	22.1		
	85	23.1	83½	22

TABLE II.

RESULTS OF SPINNING TESTS. ENGINE OFF.

Aeroplane.	Right Hand Spin.				Left Hand Spin.			
	No. of Turns.	Height Drop per Turn.	Vertical Velocity.	Time of Turn.	No. of Turns.	Height Drop per Turn.	Vertical Velocity.	Time of Turn.
		ft.	ft. per sec.	sec.		ft.	ft. per sec.	sec.
S.E.5a. B.600	10	205	106	1.93	10	210	97	2.17
Camel B.2312	10	190	95	2.0	10	130	72	1.8
	10	200	80	2.5	10	130	72	1.8

TABLE III.

RESULTS OF CONTROL FORCE EXPERIMENTS. CAMEL, B.2312.

Experiment.	Ind. Speed. m.p.h.	Engine off.		Engine on.	
		5500 ft. Force. lbs.	9500 ft. Force. lbs.	5500 ft. Force. lbs.	9500 ft. Force. lbs.
B.2312. Normal Tail Setting. No Elastic.	50	3 Push.	2 Push.	10 Push.	8 Push.
	60	4 ,,	3½ ,,	10½ ,,	8½ ,,
	70	4 ,,	4 ,,	11 ,,	9 ,,
	80	4 ,,	3½ ,,	11 ,,	8½ ,,
	90	5 ,,	4 ,,	10½ ,,	9 ,,
	100	4½ ,,	4½ ,,	11 ,,	9 ,,

TABLE IV.

RATE OF SPIN AND HEIGHT DROP.

No.	Aeroplane.	Direction of Spins.	No. of Spins.	Time, Secs.	Height Drop, Ft.
1.	D.1965	Right	5	10	—
		Left	5	10	—
2.	D.1965	Right	10	—	2000
		Right	10	20	1900
		Right	10	25	2000
		Left	10	18	1300
		Left	10	18	1300
3.	D.1965	Right	10	21	—
		Left	10	20	—
4.	B.2312	Right	10	20	—
		Right	10	21	—
		Right	10	20	—
		Left	10	19	—
		Left	10	18½	—
		Left	10	18	—
5.	B.2312	Right	10	20	—
		Right	10	21	—
		Left	10	18½	—
		Left	10	19	—

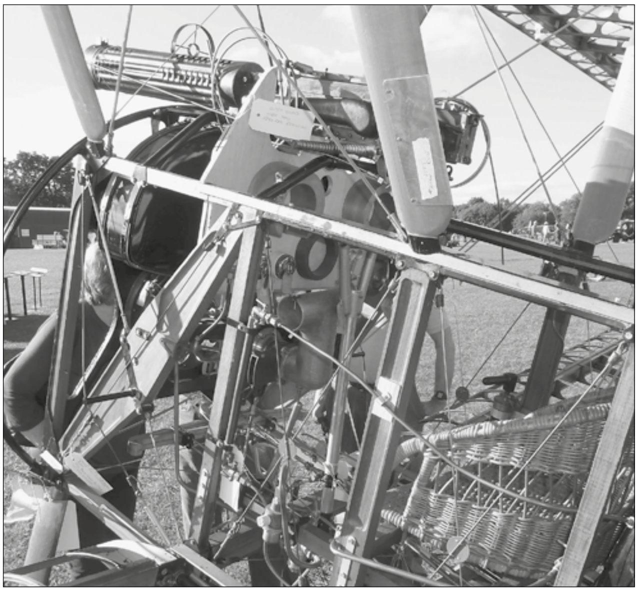
TABLE V.

TIME TO COME OUT OF A SPIN.

B.2312.

No.	Direction of Spin.	Control Column.	Rudder.	Time, Secs.	Hgt. Drop, Ft.	Max. Speed, M.P.H.	Max. Acce. in G. Units.
1.	Right	Neutral	Neutral	6	550	98	3.6
2.	Right	Neutral	Opposite	6	450	98	4.0
3.	Right	Forward	Neutral	4	450	97	4.0
4.	Right	Forward	Opposite	3	350	85	3.1
5.	Left	Neutral	Neutral	3	350	91	3.6
6.	Left	Neutral	Opposite	—	800*	89	3.9
7.	Left	Forward	Neutral	3.5	400	—	—
8.	Left	Forward	Opposite	—	500*	107	4.2
9.	Left	Back	Opposite	—	—*	—	—

*In these experiments the aeroplane started a right hand spin as soon as the left hand rotation ceased.



Although the engine, its auxiliaries and propeller are not yet installed in this photograph of the Northern Aeroplane Workshop's F.1 Camel at Old Warden, the extraordinary concentration of mass in the aircraft's forward fuselage is very evident. Going forward from the right, there are the oil and fuel tanks, the pilot's cockpit with the seat, controls and instrumentation, the Vickers gun and its sights with the ammunition container beneath it, and the engine bearer. The positioning of the tankage behind the pilot and therefore aft of the aircraft's c.g. was a noteworthy departure from previous Sopwith practice.
:Paul Ferguson

A Modern Assessment

In 2015, when the Northern Aeroplane Workshop's excellent Camel reproduction was nearing its first flight at the Shuttleworth Collection's Old Warden aerodrome, I sent a copy of the 1918 Farnborough spinning experiments to Roger 'Dodge' Bailey, who was then the Collection's Chief Pilot. His response was as follows:

The item on the Camel spinning … identifies the safest spin recovery technique, i.e. stick forward with rudder central. The difference in spin characteristics left and right are almost certainly due to the pitch and yaw rates applying torques to the gyroscope which is the rotating engine/propeller combination. It would need a cleverer chap than me to be certain, but I might suggest that the oscillatory nature of the right spin was due to the gyroscopics pitching the nose down. With the right yaw, this pitch-down would tend to recover the aircraft from the spin but, if the pilot was holding the elevator hard back, the aircraft would immediately stall and spin again until the yaw rate built up enough to pitch it down again, for as long as the pilot held the stick back this oscillation would continue ad nauseum!

… The main fuel tank in the Camel is behind the pilot and therefore well behind the c.g. (why they decided on this arrangement when the Pup and Triplane worked perfectly well with the fuel on the c.g. is a mystery to me). So, when the aircraft takes off with full fuel and full power it suffers a double whammy — aft c.g. plus the destabilising effect of tractor propeller. To counter this out-of-trim position the pilot needs to stop the nose pitching up by pushing on the stick. It is interesting to note that as the speed is increased the push force increases (but not by much), indicating some level of longitudinal stick free stability — and that is a surprise to me. I have always assumed — based on what I have read — that the Camel is longitudinally unstable, whereas this would seem to indicate that the main problem is that it is more likely to be very 'out of trim' most of the time. As no elevator trimming device is provided, the effect on pilot workload is somewhat similar, in that if the pilot is inattentive for a second or two the aircraft will take itself to the stalling angle and then in all probability spin.[9]

After he had flown the Camel Dodge *decided against a spin test programme*, but he recently told me: *I cannot add much to what I had written previously, except to say it lives up to its reputation.*

In that first great era of fighter development the Sopwith Camel was a unique combination of vice and virtue. The very embodiment of inherent instability, it was devilishly dangerous in the hands of a novice fighter pilot, but in the hands of a skilled fighter pilot it was devilishly effective.

Acknowledgement
Grateful thanks are extended to Dodge Bailey for his invaluable contribution.

Endnotes

1 Owers, Colin, 'What was the Camel Like to Fly?', *Cross & Cockade International*, Vol 55 No 2, Summer 2024, pp.55.106-55.108.
2 Stinton, Darrol, *The Anatomy of the Aeroplane* (Foulis, London, 1966), p.34.
3 Stinton, Darrol, *Flying Qualities and Flight Testing of the Aeroplane* (Blackwell Science, Oxford, 1996), p.452.
4 Macmillan, Capt Norman, 'Power to Manoeuvre', *Shell Aviation News*, No.419, 1973, pp.30-32.
5 Macmillan, Capt Norman, 'A Fierce Little Beast', *Aeroplane Monthly*, October 1984, p.556.
6 Sykes, Ronald, 'Flying the Camel in 1918', *Flight International*, 2 May 1968, p.681.
7 Ministry of Munitions, 'Experiments at RAE: Spinning of Sopwith Camel and SE5a', in *63rd report of the Controller, Technical Department, Aircraft Production*, 1918, pp.6-7 plus tables and figures. In the author's collection.
8 Ministry of Munitions, 'The Behaviour of a Sopwith Camel in a Spin', in *64th report of the Controller, Technical Department, Aircraft Production*, 1918, pp.7-8, In the author's collection.
9 Bailey, Roger, email to the author, 8 September 2015.