Aviation Science & Development at Farnborough

History and Learning Briefings

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EDWARD TESHMAKER BUSK

A True Pioneer

Edward Teshmaker Busk was an English Scientist and Engineer who pioneered early aircraft design at the Royal Aircraft Factory and was the designer of the first inherently stable aeroplane.

Busk was a remarkable man of great perseverance, judgment and method, who died tragically young in the pursuit of engineering excellence. This briefing looks at the achievements of his short, but distinguished life.

Early Research

Born on the 8 March 1886 in Rudgwick, Sussex, Busk's higher education was at Cambridge University. He obtained a First Class Honours in Mechanical Sciences in 1907 before joining the recently formed Royal Aircraft Factory, Farnborough. He had been 'head-hunted' in the early summer of 1912 by Mervyn O'Gorman, the Superintendent of the Factory, who was seeking promising university graduates from the mathematic and science disciplines.

After completing his degree, Busk spent an additional year carrying out post-graduate research on self-regulating carburetors. Following a period in industry, he then carried out private research into stresses in tension wires and into the causes and effects of wind gusts. Acting on the recommendations of Professor Hopkinson, a Cambridge Fellow, and endorsed by Dr Glazebrook of the National Physical Laboratory (NPL), O'Gorman offered Busk the position of Assistant Engineer/Physicist, which he accepted He joined the Factory in June 1912.

By late 1911, the Army had decided to hold a competition to decide with which aeroplane it should best equip itself. In December 1911, the Military Trials were announced to be held at Larkhill, on Salisbury Plain, in August 1912. The principle was that the Army should equip itself with a standard aeroplane - in the same way it had done for field gun, rifles etc. - which could be purchased in quantity and used, without modification, for a reasonable period. Cash prizes were offered to encourage the widest possible field of entries and were not restricted to only British entries.

The Royal Aircraft Factory was banned from competing, being a Government Establishment, but Mervyn O'Gorman was an *ex-officio* member of the judging panel and the technical expertise of the Factory was used to be able to accurately measure the aeroplane performances against the specification; and to design a number of new instruments. One of the more prominent new instruments, and one that was to assist greatly in the succeeding years of full scale aircraft research, was the Trajectograph.

FAST is developing a series of briefing on key aspects of Farnborough's Aviation Heritage.

These briefing notes are not intended to be a complete and comprehensive history of the subject of the title, but are intended to stimulate the imagination and encourage further reading. To that end, a 'further reading' list is included at the end of each briefing. By reading a number of different histories, written by varying authors over a range of timescales, a balance of the differences can be achieved – and the reader's own opinions formed. But we hope that these briefings will be an interesting summary.

It is a continuing process and a number of further briefings are planned.

BRIEFING SERIES

1-6 A Brief History of the Farnborough Aviation Site (1901 to 1991)

1. 1901-14 The Early Days
2. 1914-18 World War I
3. 1918-39 The Inter War Years
4. 1939-45 World War II
5. 1945-90 The Cold War Period
6. 1991 The Demise of RAE

7. Royal Engineers Balloon School
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9. Royal Aircraft Factory
10. Edward Teshmaker Busk (Scientist)
11. Frank W Gooden (Test Pilot)
12. Samuel Franklin Cody
13. The Farnborough Wind Tunnels
14. Hermann Glauert (Aerodynamicist)

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The Trajectograph was to measure a number of parameters, one of which was the gliding angle of descent of the competing aeroplane and was the first device ever to do so. It combined a pitot/static tube measuring forward velocity with a barograph measuring atmospheric pressure (and thus altitude), each instrument recording its readings on a chart upon which time intervals were marked by a pencil operated by a clockwork motor. The whole system, which had been the brainchild of Mr F Short, was mounted in a wooden box and fitted to the competing aeroplane. He took charge of it during the trials and was ably assisted by Busk. This must have been one of Busk's early duties at the Factory.

This type of device was obviously a prime method of collecting scientific data in full-scale flight and Busk set to work to design a similar machine to help with his work on aeroplane stability. On the 4th May 1913, Busk attended a soiree of the Royal Society in order to display his, and the Factory's, newly developed test instrument - the Ripograph. Similar to the Trajectograph, it recorded on a single photographic strip, the pilots movements in warping and steering, together with speed, inclination, roll angle and elapsed time - an ideal instrument to bring science to his deliberations on stability and control.

Above : Busk piloting one of his experiments in the second RE1, No 608, completed in September 1913, showing the curved balance area forward of the rudder, and the small rounded fins fitted on the upper wing , one above each pair of inter-planes and centre-section struts.

Learning to Fly

Busk's work on stability used entirely different principles to those advocated by Dunne some six years previously; and to understand the problems at first hand, rather than through the interpretations of a test pilot, no matter how accomplished they were, he learned to fly under the tutelage of one of the factory test pilots, Geoffrey de Havilland.

Busk continued his test flying looking at stability as a complete aircraft problem and many small design changes contributed to the overall solution. By the use of wind-tunnel models as well as full scale flight testing, the product of that research resulted in the RAF RE1, completed in May 1913 and handed over for test flying two months later. This was the Factory's first inherently stable aeroplane and had been a joint effort between Geoffrey de Havilland, Henry Folland and Edward Busk. This first aircraft, numbered 607, was used by Busk for a lengthy programme of test flying and development in connection with his stability programme.

Over a period of some months, the dihedral angle was progressively increased from one degree to something in excess of three degrees. The fin area was reduced, that of the rudder increased, and a new tailplane of rectangular platform substituted for the original. These modifications gave longitudinal stability, but lateral stability proved difficult to achieve with warping wings, as their tendency to self warp in gusts was excessive.

New wings incorporating ailerons were therefore fitted, and were rigged with their stagger reduced by four inches. On the 25th November 1913, Busk was able to fly the machine for seven miles without touching the aileron control, relying on the dihedral to control the roll in gust. Turns were made on rudder alone, the machine automatically taking up the appropriate angle of bank. At last the Factory had an aeroplane that could be successfully used by the Army in their reconnaissance and photography role; and in which the pilot and observer could concentrate on their primary role - in a stable platform - rather than spending all their time controlling the aircraft.

The Revolutionary BE2c

All of Busk's investigations were incorporated into the BE2c, almost a totally new design from the previous BE1 and 2s, but retaining a family resemblance to its forbearers. Busk had taken the Factory's most popular design in the form of the BE2b 602, and used his experiences with the experimental RE1 flight tests to modify the BE. He added a triangular fin, substituted a new non-lifting tailplane of almost rectangular platform; and introduced 24 inches of positive stagger by moving the lower wing back to return the centre-of-pressure to its correct position, following the loss of lift previously contributed to the tailplane. The wing structure was almost totally new, being of RAF6 aerofoil section with ailerons replacing the wing warping used in the previous models. The dihedral angle was increased to three and one half degrees and cut-outs made in the trailing edge of the lower wing roots to restore the pilots view of the ground.

Busk took the converted 602 for its first flight on 30th May 1914 and on the 9th June it was flown to the Royal Flying Corp's "Concentration Camp" (a gathering at Netheravon to concentrate under canvas the full strength of the new Corps in order to test its mobilisation ability and efficiency – see Briefing No. 8). Its pilot was Major W S Branckner, a not widely experienced pilot, of whom was amusingly, and somewhat remarkably noted, *"…after climbing to 2000 ft and setting course, he was able to make the forty-mile journey without placing his hands on the controls until he was preparing to land. He spent his time writing a report on the countryside passing below, although he did admit to the inclusion of a number of extraneous dots and dashes caused by the more violent bumps or gusts."*

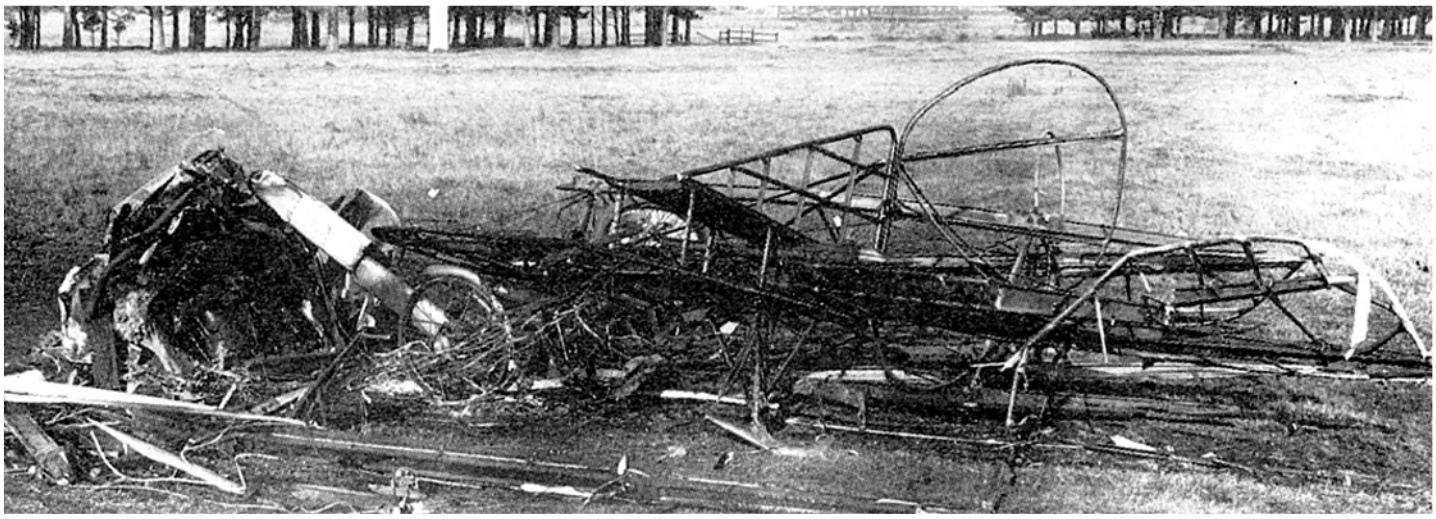
Above : The BE2c - a major advance in aircraft stability

This demonstration of the benefits of inherent stability - just what the RFC were looking for at the time - was sufficient to ensure that the BE2c was put into production by private constructors, to supersede the earlier variants in service with the RFC. Clearly, Busk had carried out his research and development with a passion that was to significantly affect the design of aircraft far into the future - some 2000 BE2c's were built by the British aeroplane industry.

A Tragic Early End

Busk continued to fly experimental aircraft and on 27 September 1914 suffered an engine failure in an RE3 - an aircraft similar to the later RE2 but fitted with a 120hp Austro-Daimler engine - and crashed on Farnborough Common, fortunately without injury.

It was, however, in an earlier BE variant - 601, which had been converted to a BE2c that Busk met his death, in a flight over Laffans Plain. In the issue of Flight magazine for December 17th 1925, Busk's end was described thus: "It was on November 5th 1914, fittingly as the sun was setting, the light of Busk's life passed away. When about a 1000ft up, his machine burst into flames and glided down on Laffans Plain at Aldershot, the pilot being incinerated".



Above : The remains of Busk's BE2c November 5th 1914 on Laffans Plain, Farnborough

On 18th November 1914, the Council of the Aeronautical Society chose to recognise Edward's distinguished services to aeronautical science with the posthumous award of the Gold Medal of the Society, their highest award. Colonel Mervyn O'Gorman, CB summed up the life and work of this remarkable man in the obituary notice:

"He resembled other men of genius in the simplicity of his methods and the speed at which he worked, and he was remarkable for the soundness of the scientific judgments he arrived at. His youth, for he was only 28 years of age, is an added cause for regretting the termination of a career so brilliantly commenced."

Buried, four days after the accident, in the Aldershot Military Cemetery, close to Cody's grave, Busk's memorial was moved when the RAE was closed and still overlooks the airfield, the Black Sheds and Laffans Plain from the FAST Museum.

Right : The gravestone of E T Busk

Article by Dr Graham Rood 2011