The Enigma of the Aerofoil : Book Review by Fred Starr

"The Enigma of the Aerofoil – Rival Theories in Aerodynamics 1909-1930" by DAVID BLOOR Pp 547 University of Chicago Press 2011, £23.49

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The usual explanation to account for the ability of an aerofoil to provide lift is not correct. It is asserted that the curvature of the top surface of a wing results in the air having to flow faster in getting from the leading to the trailing edge, compared to the flow over the lower surface. From the Bernoulli effect, the difference in the velocity between the two airflows results in a pressure difference which gives lift.

In his brilliant book, David Bloor shows how the correct explanation, based on the "circulation theory" was developed in Germany. Bloor shows how, after many years, the theory was reluctantly accepted by the team at the NPL in Teddington, largely through the efforts of the Englishman, Herman Gluert, whose father was German.

Bloor argues that Lord Raleigh, in developing the impact theory of lift, set the Mathematics Department at Cambridge University on the wrong track. It was these academics, closely associated with the aerodynamicists at the NPL, through the Advisory Committee for Aeronautics, who set Britain against the circulation theory.

Back in 1896, FW.Lanchester (the engineer) had conceived the basics of the theory, but his account was marred by the obscurity of his writing and through it being just a qualitative account. The German work was a more or less independent initiative, starting from Kutta's assumption in 1902 that a circulatory flow existed, which allowed him to give a good prediction of wing lift. In 1910, the circulation theory was extended by Joukowsky to develop aerofoils that had some semblance to modern shapes. During WWI, outside of Germany, designers clung to relatively thin, concave sections which were structurally and aerodynamically inefficient.

Although Lanchester was on the Advisory Committee, he was unable to make any headway and soon resigned. Here we have an incongruity. We in Britain pride ourselves on our pragmatism. The fact that the German work was going somewhere, in terms of developing aerofoils, and was giving predictions of pressure distribution, counted for nothing.

But the Advisory Committee had good reason to reject the circulation theory, as it assumed that air had no viscosity, and it was a well known principle that a circulatory flow could not develop in a perfect fluid. At the NPL the focus was on the Navier-Stokes equations, which can handle viscosity effects. Useful results did not follow quickly. In fact we needed to wait until today's era of advanced computers.

Bloor does a magnificent job in bringing in all the major and minor characters. Even Einstein had a shot at designing wing sections! He details the contributions made in Germany, and why key individuals in this country were so dismissive. Bloor handles

the use of mathematical equations very well, without disrupting the flow of the text, and includes many diagrams from the period and pictures of the protagonists. The book ends with an analysis of the philosophy and practice of scientific advance, which was perhaps a chapter too far. But altogether, a first class effort.

Fred Starr : 2011