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The impact of the women of the Technical Section of the Admiralty Air Department on the structural integrity of aircraft during World War One

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Abstract

In 1917, as the air war raged in Europe, some of Britain's finest mathematicians, engineers and scientists engaged in their own battle to understand the fundamentals of aerodynamics and aircraft construction. In London, Wing Commander Alec Ogilvie led the Technical Section of the Admiralty Air Department, which included a number of individuals dedicated to addressing aircraft structural issues; amongst them were three women, Hilda Hudson, Letitia Chitty and Beatrice Cave-Browne-Cave. In this article I describe the aeronautical landscape in Britain during the second decade of the 1900s, the place of these women within it, and their contributions to the structural integrity of early, British military aircraft.

Sommario

Nel 1917, mentre in Europa infuriava la guerra aerea, alcuni tra i migliori matematici, ingegneri e scienziati britannici combattevano per carpire i pricipi dell'aerodinamica e della costruzione aeronautica. A Londra il Tenente Colonnello Alec Ogilvie dirigeva la Sezione Tecnica del Dipartimento aereo dell'Ammir-agliato, che includeva un gruppo di persone dedicate alle problematiche strutturali dei velivoli. Tra queste vi erano tre donne: Hilda Hudson, Letitia Chitty and Beatrice Cave-Browne-Cave. In questo articolo descrivo il panorama areonautico durante la seconda decade del 1900, il ruolo di queste donne all'interno in quell'epoca e il contributo che hanno apportato all'integritá strutturale della prima aeronautica militare britannica.

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1. Introduction

In 1909, Richard Burdon Haldane, British Minister for War, viewed developments in aviation with interest, conscious that the revolutionary heavier-than-air machines would undoubtedly be key participants if, as seemed likely, hostilities commenced in Europe. He considered it prudent, therefore, to engineer a measure of control over the rather disparate band of aeronautical protagonists who had emerged during the previous decade. Consequently, on the 30th April of that year, he formally established the Advisory Committee for Aeronautics (ACA), a body of men that would orchestrate the early evolution of British aviation. Louis Blériot's historic flight in his Type XI aircraft across the Channel less than three months later brought Haldane's prescience into sharp focus, as it became apparent to most that Britain could no longer hide behind its impressive navy; to remain impervious to the threat from the air would be folly.

The potential importance of the ACA was clear, so Haldane knew its leader had to be someone with established credentials; an obvious candidate, a man with gravitas and credibility in abundance, was John Strutt. Better known as Lord Rayleigh, Strutt was a heavyweight in contemporary science and mathematics, already regarded as a world authority in the field of acoustics following publication of his two-volume work, *The Theory of Sound* (Lord Rayleigh, 1877, 1896); he was also a Nobel Laureate.[1] He had indicated his personal interest in aeronautics as early as 1891, authoring a review in *Nature* (Lord Rayleigh, 1891) of Langley's *Experiments in Aerodynamics* (Langley, 1891). His subsequent delivery in Manchester of the Wilde lecture in 1900 entitled *The Mechanical Principles of Flight* (Lord Rayleigh, 1900) updated his credentials and this, combined with his experience in hydrodynamics, gave him the perfect résumé.[2] In fact Rayleigh would become the driving force behind the discontinuity theory of aerofoil lift, championed by Britain until the post-war era, when the circulatory theory, most associated with the German engineer Ludwig Prandtl, was seen to reflect a much closer representation of reality.[3] Interestingly, Frederick Lanchester (1868–1946) had been arguing the merits of a circulatory component in theoretical lift analysis for years, but this solitary British voice was lost amidst the noise in support of Rayleigh's penchant for the alternative.[4]

Someone taking a macroscopic view of aeronautics in Britain at the start of the second decade of the 20th century would have witnessed a veritable potpourri of influences; that said, broad delineation is possible: the Royal Balloon Factory, the National Physical Laboratory (NPL), industry, academia, and the Admiralty, were all salient players. Faced with this rather eclectic fellowship, it made sense for Rayleigh to source the members of his committee, reasonably evenly, from the aforementioned. We thus see Mervyn O'Gorman and Richard Glazebrook chosen to represent the two research establishments, Frederick Lanchester and Arnulph Mallock co-opted from industry, academics such as Alfred Greenhill (who had recently retired from the Royal Military Academy) and Joseph Petavel from Manchester University, and, inevitably, representatives from the Army and Navy to reflect the burgeoning military interest in aviation. The new Advisory

[1] Rayleigh received the Nobel Prize for Physics in 1904 in recognition of his discovery of the noble gas, argon, in 1894.

[2] The Wilde lecture was named after Henry Wilde, F.R.S., electrical engineer and President of the Manchester Literary and Philosophical Society, 1894–1896.

[3] The discontinuity theory's origins in this context dated back to Rayleigh's 1876 paper *On the Resistance of Fluids* in which he notes when talking of a flat lamina at an angle to a water flow that, "Behind the lamina there must be a region of dead water bounded by a surface of discontinuity, within which the pressure is the same as if there were no obstacle. On the front face of the lamina there must be an augmentation of pressure ..." (Lord Rayleigh, 1876, 434). The circulatory theory of lift argued that the presence of an aerofoil in an airflow induced a circulation of air around it which modified the normal flow in a way that reduced pressure on the top surface whilst increasing it on the lower. See Bloor's *Enigma of the Aerofoil* (Bloor, 2011) for a comprehensive discussion of this dichotomy.

[4] Lanchester had actually postulated a circulatory explanation for lift in his book *Aerodynamics* (Lanchester, 1907), but a perceived lack of rigour in his mathematics, coupled with his engineering background, made Rayleigh's offering more plausible.

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