The Siddeley – Deasy Sinaia Heavy Bomber and Orford Ness.

By early 1918 Orford Ness had become a centre of excellence for areas of military flying ranging from flares to gun mounts and offensive and defensive flying training to tactics and procedures. Copious evidence exists of knowledge exploitation from Orford Ness to assist industry in producing items such as flares and bomb sights. Until recently evidence of knowledge exploitation into aircraft design had not come to hand. A file recently found in The National Archives (TNA) shows how Orford Ness knowledge was exploited into the design of the Siddeley -Deasy Heavy Day Bomber.[1]

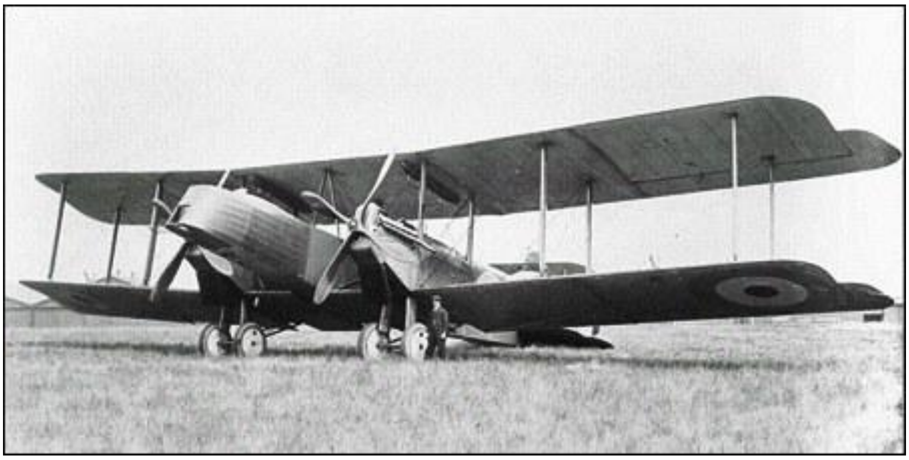

Figure 1. The Siddeley-Deasy Sinaia Heavy Bomber.

The Siddeley-Deasy Sinaia was a twin-engine biplane day bomber with gunners in rearwards extensions of the engine nacelles. Although the outline aircraft specifications are known, all other information was lost in a factory fire during WW2.

The Orford Ness Report

In early 1918 the Air Board tasked Orford Ness to provide an advisory note to Siddeley – Deasy on the navigation, bombing and self-defence requirements for the Sinaia. The report, which was prepared by then Maj. B Melvill-Jones[2] and issued on 31st March 1918, provides an extensive distillation of the knowledge that had been gained during studies

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[1] TNA. Air 2/732. Multi-engine bomber. Notes by Armament Experimental Station, Orford Ness. March 1918.

[2] Bennett Melvill-Jones was a graduate of Emmanuel College, Cambridge where he had taken the Mechanical Sciences Tripos in 1909. After graduating he worked variously in the Aerodynamics Department of the National Physics Laboratory and at Armstrong Whitworths where he worked on the design of airships until the outbreak of war in 1914. He was then seconded to the Royal Aircraft Establishment until 1916 when he was transferred to Orford Ness. In March 1919 he returned to Cambridge as a fellow of Emmanuel and a member of staff of the Engineering Department. In October he was elected as the first Francis Mond Professor of Aeronautical Engineering. When Sir Melvill Jones died in 1975 at the age of 89, his life had spanned virtually all the major advances in twentieth century aerodynamics.

into tactics and procedures over the preceding twelve months. In essence the report addresses the optimisation of the fightability of the airframe, where fightability is a term to describes how appropriate design permits the crew to maximise the lethality and effectiveness of a military asset. This was not, however, the first occasion on which Melvill-Jones had written a paper on the design of a possible new airframe.[3] That paper will be discussed in a future article.

Melvill- Jones's paper is divided into three sections; navigation, high-altitude bombing and defence against enemy aircraft. In the section of navigation Melvill-Jones suggested that there were four methods which could be employed. [4] He discusses how the pilot and observer must be co-located, as close as possible to talk and exchange notes, thereby ensuring effective and accurate navigation of the airframe. The observer needs good all-round unobstructed vision to allow viewing of the ground and taking sextant readings on the sun or stars. The pilot needs unobstructed forward vision and direct downward vision of about 15 degrees below the horizontal. The pilot should not, he insists need to look over the side of the airframe to ascertain position.

In the next section Melvill-Jones admits that *"we have little experience of high-altitude bombing"* [5] and that his observations may require revision *"as a result of the high bombing experiments in progress."*[6] The results of these trials actually supported Melvill-Jones's advice.[7]'[8]

He states that the pilot and observer must be involved in the bombing process, the main point of conjecture being who should steer the aircraft onto the target. If the pilot steers for line he would need an unobstructed view both forward and downward, which could only be achieved if he were seated in the extreme front of the aircraft. In addition to the requirements for special controls, he would also be remote from the observer, so seriously degrading effective navigation (see above). In this situation the observer would require a clear field of view through the cockpit floor, using a negative lens bomb sight (see below). With the observer steering for line the main requirement would be both they, and the pilot, who needs to fly straight and at a steady speed, have the same vision requirements as for navigation. Melvill-Jones completed this section by re-

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[3] TNA Air 1/1200/204/5/26510. A56. Suggestions for a two-seater fighter. July 1917.
[4] These were:

- Directly following the ground with a map
- Dead reckoning from known wind direction and strength
- Sextant observation of sun or stars
- Wireless directional signals.

All but the last method had been thoroughly researched by personnel stationed on Orford Ness. Melvill-Jones admits that they had *"no experience of this type of work and hence are in no position to discuss it."*
[5] ibid
[6] Ibid.
[7] TNA Air 1/1200/204/5/26510. G58. Bombing done by 3 pilots and observers from Expeditionary Force on Orford Ness. September 1918
[8] TNA Air 1/1200/204/5/26510. G63. Railway bombing from great heights. October 1918.

iterating why direct forward vision with a 15-degree depression below the horizon was essential for effective bombing.[9] He stressed that it was essential that the observer and pilot were well trained in the art of bombing.

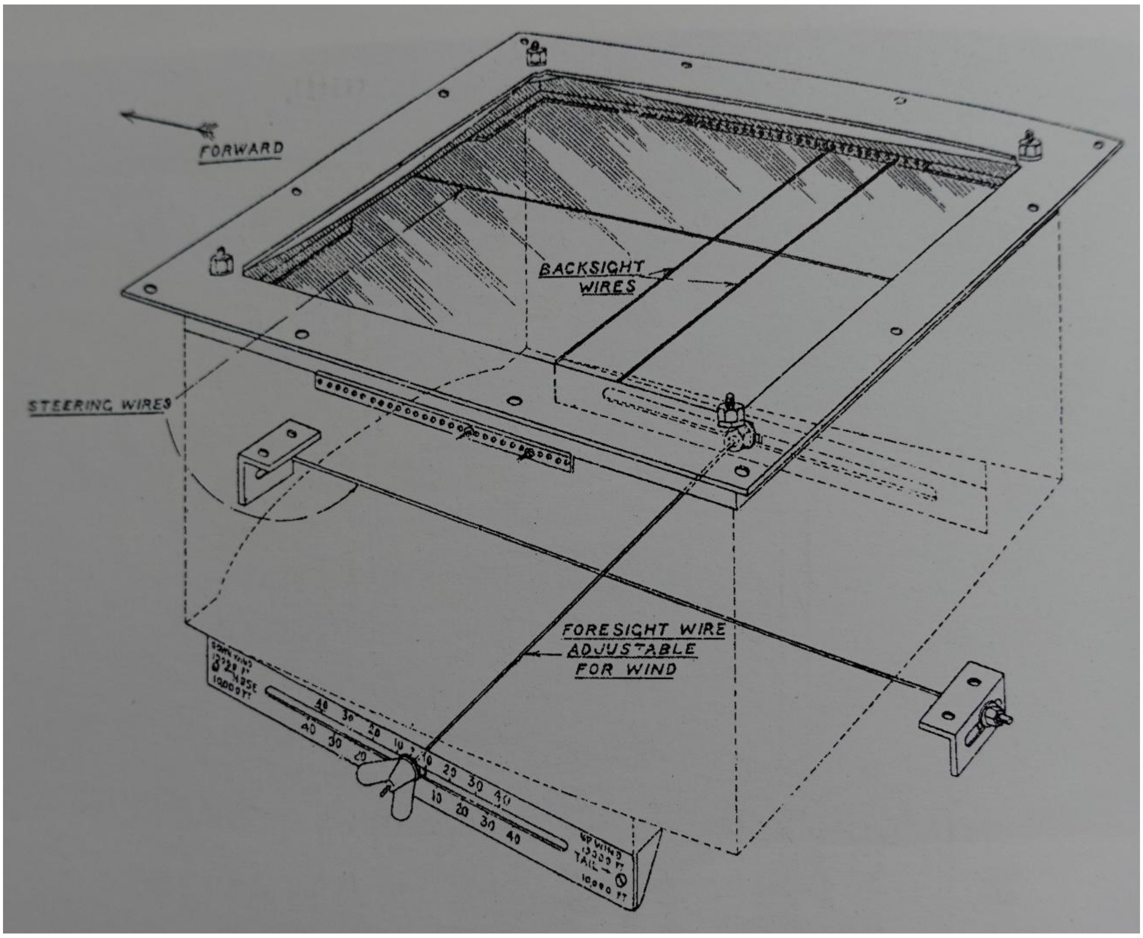

Figure 2. Schematic of negative lens bomb sight.[10] (reproduced by kind permission of Wg Cdr C G Gifford).

The implementation of negative lenses for bomb aiming had been extensively investigated by Orford Ness during 1917.[11] In essence the bomb sight (Fig.2) was a rectangular box mounted in a hole in the floor of the cockpit. The upper face of the box contained a convex (negative) lens which provided a panoramic view of the ground below and ahead. Longitudinal sighting wires were stretched centrally above and below the lens to approximate the vertical plane and to help in lining up on a target. The

[9] The reasons given by Melvill-Jones were

- At great altitudes there are no distant landmarks to assist in straight flying near the horizon
- That the pilot will have a better chance of picking up a target with which he is unfamiliar .... than if he has to look over the side for his forward view.

[10] Gifford, C.G. Observers and Navigators and Other Non-Pilot Aircrew in the RFC, RNAS and RAF, Grub Street, 2014,pp 384

[11] See, for example TNA Air1/1200/204/5/2610. G 20. Negative lens used as photographic sight in D.H.4 dated 4 June 1917 and G33. Position of negative bombsight in Bristol Fighter "R" type dated September 1917.

backsight was 3 fixed wires arranged laterally across the top of the box and which approximated to three bombing altitudes and fixed airspeeds. The foresight was a wire stretched laterally across the bottom of the box, the position of which could be altered to compensate for windspeed. The sight was relatively easy and comfortable to use but was inaccurate. It was only effective in fore and aft bombing and the backsight had to be set before flight.

The information on defence against enemy aircraft had been gathered during an extensive series of studies of mock day and night fighting.[12,13,14,15]After briefly reviewing the armament requirements for light three-seater fighters, Melvill-Jones established the need for a rear facing gunner who has unrestricted vision. Given that the Sinaia would be heavier and slower than a fighter Melvill-Jones recommends one gunner located at the front of the airframe and two rear facing gunners whose gunnery station would be in a nacelle behind each of the engines. He dismissed the notion of a single rear gunner, as this would require the person to be located beyond the tail! Melvill-Jones also noted that the rear gunners had to command the upper hemisphere to prevent attack from above, and for that they would be needed to be located level with the top wing of the aircraft. He conceded that this requirement would be extremely difficult to achieve.

Finally, Melvill-Jones recommended that the most effective self-defence weapon would be a double Lewis gun mounted on a Scarff ring. A study undertaken in France had clearly shown that such an arrangement was the most lethal for airframe defence.[16] Melvill-Jones had produced a succinct report in just over five pages which presented clear information on the key fightability requirements.

The Siddeley-Deasy Response.[17]

This was prepared by the Chief Engineer, F.M. Green, who had joined Siddeley-Deasy from the RAE in early 1917. He stated that they could not meet the field of view requirements for the pilot as Melvill-Jones had laid out, and that for any ground picture the pilot would need to look over the side of the cockpit. As a compensatory measure the Sinaia had been equipped with a large negative lens in the aircraft floor which could be used by either crewman. Further, because of the installation of a Coventry Ordnance 1 pound gun as the forward armament, the pilot could not be placed in the front of the aircraft. As a result, the direction of line would be under the control of the observer.

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[12] TNA Air 1/1200/204/5/26510. A60. Long range firing between aeroplanes. August 1917.
[13] TNA Air 1/1200/204/5/26510. A65. Fighting between aeroplanes at night. September 1917.
[14] TNA Air 1/1200/204/5/26510. A66. Long range air shooting. October 1917.
[15] TNA Air 1/1200/204/5/26510. A82. Night fighting in the air. April 1918.
[16] TNA Air 1/1200/204/5/26510. A81. Adaptor for two Lewis guns on a Scarff No.2 ring mount. February 1918.
[17] TNA. Air 2/732. Notes on Orford Ness Report on Multi-engine bomber. April 1918.

Green confirmed that there was a crew of four; pilot, observer and two rear gunners in each of the engine bodies. Green went to great lengths to demonstrate that the position of the two rear gunners resulted in only one blind spot, but which could not be exploited by an enemy aircraft. The rear gunners were currently equipped with 1.5-pound Coventry Ordnance cannons, but he suggested that a future modification to a twin Lewis machine gun could be undertaken. Green concluded that the Sinaia met all the requirements of Melvill-Jones's report, save the degree of forward downward view for the pilot. Green then adds a tantalising observation that the 1-pound forward gun could also be replaced by a Lewis machine gun!

Although four aircraft were ordered only two were ever built. One was constructed at Martlesham Heath, the other at the Coventry works, both of which were completed after the end of WW1. Consequently, there was no real desire by either the RAF or Siddeley-Deasy, now Armstrong-Siddeley to develop the aircraft further. A critical failure of the airframe following a test flight in 1925 marked the end of any further work on the Sinaia. What remains a mystery was whatever happened to the Martlesham Heath airframe?

Concluding Comments.

The papers discussed in this report are, to date, the only known example of knowledge exploitation from Orford Ness to a private contractor to assist in the construction of a complete aircraft.

The initial steps in any procurement process are for a specification to be drawn up by expert military officers within the appropriate military branch in, today, the MoD. This will be supported by specialist advice which will help any potential contractor develop a response[18] During WW1 the specification would have been drawn up by a desk officer in a branch of the Air Board latterly the Air Ministry. In developing this specification, it is probable that advice would have been sought from the Royal Aircraft Establishment (RAE) on, for example, airframe design for optimal aerodynamic stability. Here, however, Melvill-Jones was specifically directed to provide design information which would enable the aircrew of the Sinaia to fully exploit the capabilities of the airframe. In short, he was using the information gleaned from tactic and procedures research (e.g most effective way to bomb targets) to help in the design of the Sinaia. It is this observation which suggests that this was the first time that such knowledge had been exploited and it had come solely from research undertaken on Orford Ness. By the Cold War it became regular practice to include operational research and human science information to the potential designers of all military platforms and equipment.

Of further importance is that work described by Melvill-Jones was part operational research, for example optimal arcs of fire and part human science, co-location of

[18] For a detailed description of military procurement see [Understanding Defence Procurement In The UK | Defence Contracts International]

aircrew to allow optimal communication. By mid-1918, Tiverton and A V Hill were undertaking studies into strategic bombing and effective anti-aircraft gunnery respectively. These studies have been recognised as early precursors of military operational research.[19] In this paper we can see that work on Orford Ness was supporting this discipline.

A further strength of these papers is that, until now, the Sinaia aircraft and engine specifications were well known,[20] but little other information had come to light. From these exchanges we now know that Siddeley-Deasy considered that the cockpit should be provided with a large negative lens to improve downward vision. In addition, the aircraft was equipped with 1- and 1.5-pound Coventry ordnance cannons. Whilst these are relatively minor pieces of information, they are a contribution towards our knowledge of the Sinaia.

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[19] McClosky, Joseph, H. (1987). The beginnings of Operations Research: 1934 – 1941. Operations Research, Vol.35, No.1.

[20] Siddeley-Deasy Type Sinaia (Armstrong-Whitworth Sinaia) | Secret Projects Forum