Cross-fertilisation of aircraft and aero-marine design

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CROSS-FERTILIZATION

OF

AIRCRAFT AND AERO-MARINE DESIGN

BY

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PREFACE

Why Cross-Fertilization as the subject of a thesis? The answer is somewhat complex, and starts in 1944, with the author frustrated following his selection for pilot training in the Fleet Air Arm by the war in Europe drawing to a close. Instead he was trained in aircraft design and manufacture as a *General Aeronautical Engineering Apprentice* by the *Blackburn Aircraft Company*, at Brough on the River Humber. *Blackburns* was an old seaplane manufacturer which specialised in building aeroplanes for the Royal Navy. There he was also taught to fly.

Eventually, via the design and stress offices of the *De Havilland Aircraft Company*, and a permanent commission in the RAF, the author qualified as a test pilot. Throughout and afterwards he kept his roots in aircraft design, with the intention of combining both. It is a rare and difficult combination in the UK. While it did not succeed in the same way as for Sir Geoffrey De Havilland when younger, or Kurt Tank, the German designer of the *Focke Wulf Fw 190* and *Ta 152*, it has worked in unexpectedly satisfying other directions.

The thesis is submitted in a box, and consists of a number of parts which are already published. The reason for this is that the author had no intention until a few months ago of presenting a thesis to anyone, let alone a university. Much of his published work lends itself readily to the subject of Cross-Fertilization (between the separate disciplines of naval architecture and aeronautical engineering). The presentation of parts is introduced below. Each is referred to as (Part 1 or 2, etc).

Lectures to the Empire Test Pilot's School, initially on aircraft structural design, to prevent student test pilots breaking and bending aeroplanes, led to publishing his first book, *THE ANATOMY OF THE AEROPLANE* (Part 1). This has been rated internationally as a classic, and is still demanded for reprint in the first edition 25 years on. The following book, *THE DESIGN OF THE AEROPLANE* (Part 2), is now also rated as an international classic. It is used in design offices world-wide, and is the standard text in colleges, universities and training establishments, in both hemisphere from *Seoul*, to *Massachusettes Institute of Technology*, to *Salford University*, to *Haarlem* in Holland.

Both of these books are submitted in support of the thesis. Both contain chapters intended to keep alive knowledge of seaplane design. The maritime strike/reconnaissance flying-boat (Part 1, Fig E.5.3), shown in Fig 10.1, is said to have been used as a reference by the Japanese company *Shinmeiwa*, during early stages of designing the broadly similar *PS-1*.

During RAF service the author carried out original research on mistake-making, and the efficiency of pilots in man-machine systems. This was published and used by the *RAF Institute of Aviation Medicine* in an *Aircrew Disorientation Programme* in the early 1960s, and was successful in the re-treading of a number of pilots who would otherwise have been discharged on medical grounds. A summarised version, *MISTAKE-MAKING IN MAN-MACHINE SYSTEMS*, is copied from a book published by the *Society for Underwater Technology* (Part 3, Chapter 20). It is relevant to cockpit and crew compartment design in aircraft and sea-going vessels of all kinds. It is relevant to the loss of the Ro-Ro ferry, *Herald of Free Enterprise* in Zeebrugge Harbour, in 1987, and it is also relevant to diving operations. The author qualified in 1965 as the only *Ship's Diving Officer (RN)* then serving in the RAF. In Singapore he formed and led an RAF team of divers, which he trained to work with the Navy in the event of aircraft accidents in water. Later, he formed and led the *Royal Air Force Sub-Aqua Association*, which is large, and which undertakes marine archaeological and research expeditions, as well as providing assistance in the event of military aircraft accidents at sea. With this organisation he is still involved.

In 1967 the author was a staff officer in *Operational Requirements Branch of MoD(AIR)*, as a specialist in aircraft design. He was also (privately) consultant Chief Designer under Hugh Latimer Needham, to *Phoenix Aircraft* of Cranleigh, which produced the pre-war *Luton Minor* and *Major*. While with the *OR Branch* the author devised a parametric means of assessing aircraft, as a means of testing beforehand the claims of manufacturers for exaggeration and untruth. Years later it was published in *Interavia*, and later still, in 1991, a developed version was used by the author in a series of lectures to the *Agency for Defence Development* in Korea. That version, with the Korean aeroplane excised at the request of *ADD*, forms Part 4.

During 1967 the author designed the first wedge-aerofoil racing car, for *Alan Mann Racing*, which changed racing car design internationally. His work and publications on modern airship projects around 1969 is said to have been responsible for their subsequent re-emergence.

In 1969 the author joined the then *Air Registration Board*, which became the *Civil Aviation Authority*, as a *Design Surveyor-Test Pilot*. For the next 20 years he specialised in the design survey and test flying of landplanes and seaplanes for the award of Certificates of Airworthiness. Part 2 was written as a handbook, inter alia to assist designers and engineers having difficulty with the certificating authorities.

From 1969 the author continued to teach aircraft design, and to lecture on test flying and flying qualities, at the *Empire Test Pilot's School*, to Branches of the *Royal Aeronautical Society*, and to undergraduates at, eg, Loughborough, Bath, Bristol and Glasgow universities. The RAeS' John Britten Prize-winning paper, *IMPROVING THE FLYING QUALITIES OF YOUR AEROPLANE* (Part 5) was given originally by the author to a Symposium of the *Experimental Aircraft Association*, at Oshkosh, Wisconsin.

In 1982, realising that test flying for the *CAA* might end earlier than expected (ie, 1989 instead of 1992), the author and his lawyer-wife formed *DARROL STINTON LIMITED*, a company of aero-marine consultants. He was elected a corporate Member of the *Royal Institution of Naval Architects*, on the basis of his knowledge of seaplane design.

The following four papers deal directly with cross-fertilization, which the company was formed to provide. First, *AERO-MARINE DESIGN AND FLYING QUALITIES OF FLOATPLANES AND FLYING-BOATS* (Part 6) won the *George Taylor (of Australia) Prize* of the *RAeS*. Second, *AIR AS A MEANS OF INCREASING THE CAPABILITIES OF SURVEILLANCE, PILOT AND RESCUE CRAFT* (Part 7), was given at an international conference of the *RINA* in Southampton, in 1990. The third, on *sail-hull lead* (the arrangement of hull and sail areas to achieve trim, sea-kindly handling, and aero-hydrodynamic directional stability) was to have been a paper in its own right. But an old and revered naval architect, Austin Farrar, had entered a paper on the subject, and it was kinder to present the author's in support of Farrar's. The paper therefore masquerades as *DISCUSSION* (Part 8), of *SAIL-BALANCE - A NEW RULE OF THUMB*, by AP Farrar (Fellow), breaking fresh ground for naval architects with applied aircraft design principles. Fourth, *RAM-WING SURFACE CRAFT* (Part 9), was presented at a *RINA* conference in 1990 to introduce fresh ideas.

It should be added that aeronautical techniques are ahead of the older science and art of naval architecture, as naval architects themselves are beginning to admit. Aero-marine cross-fertilization is a hitherto uncharted subject for the naval architect and marine engineer, even though it might seem an obvious adaptation to the aircraft designer and aeronautical engineer.

With this in mind the author, as the elder *Vice President* of the *Royal Aeronautical Society*, has suggested to the *Professional Standards and Grading Committees* that, out of economic necessity brought on by recession, there should be a policy adopted by the Society of

providing active support for cross-fertilization. Many young engineers are drawn into engineering by the glamour of aeronautics, and it has the greatest catchment still of any engineering subject. For many and varied reasons, usually economic, they transfer to other work on graduation. They then find that the Society is of no help to them in achieving *CEng* status, because they are unable to satisfy the '.....in aeronautics....' requirement. The author holds that the Society must continue to look after its graduates, and nurse them through to chartered status, even though they have moved into other fields, as long as they are employing aeronautical knowledge, training and skills in their new occupations. Aeronautics, after all, is probably the most wide-ranging cross-fertilizer of disciplines , when one considers what has flowed from it in terms of technological advance. He looks to his long association with Loughborough, as a leading centre of technological learning, for support in bringing cross-fertilisation, and moral support for engineer graduates in particular, to the attention of all who are concerned with professional standards in engineering.

The author is pleased to present this thesis on aeronautical and marine cross-fertilization as one example of a much broader subject worthy of study by modern engineers.

ANNEXED PARTS

1. *The Anatomy of the Aeroplane* (1966). Oxford: BSP Professional Books.

2. *The Design of the Aeroplane* (1983). Oxford: BSP Professional Books.

3. *Mistake-Making in Man-Machine Systems* (1988). Copied from Advances in Underwater Technology, Ocean Science and Offshore Engineering, Volume 15, Proceedings of an International Conference (Technology Common to Aero and Marine Engineering) organised by the Society for Underwater Technology held in London, UK, 26-28 January, 1988. London: Graham & Trotman Limited.

4. *A Parametric Method of Comparing Aircraft* (1991). Sessions 3 and 4 of Lectures given to the Agency for Defence Development, Taejeon, Korea. Farnham: Darrol Stinton Limited.

5. *Improving the Flying Qualities of Your Aeroplane*: extract from Aerospace - March 1985. London: The Royal Aeronautical Society.

6. *Aero-Marine Design and Flying Qualities of Floatplanes and Flying-Boats.* Reprinted from The Aeronautical Journal of the Royal Aeronautical Society, March 1987.

7. *Air as a Means of Increasing the Capabilities of Surveillance, Pilot and Rescue Craft.* International Conference on Surveillance, Pilot and Rescue Craft for the 21st Century, 13th and 14th March 1990, Southampton. London: The Royal Institution of Naval Architects.

8. *Discussion Document in support of a Paper: Sail-Balance - A New Rule of Thumb*, by AP Farrar. Transactions of The Royal Institution of Naval Architects, Part A, Vol 33, 1991.

9. *TN(M)006, Ram-Wing Surface Craft.* A Paper presented to the Fast Craft - Sail and Power Conference of the Royal Institution of Naval Architects, November 1990.