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BAHG Newsletter

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Flying Bedstead at Thurleigh in 1957, control tower in background (C1834/B3575)

P1127 and Short SC1 together in 1968

RAeS 150 As mentioned in the last issue, the Bedford Branch of the Royal Aeronautical Society has arranged a special event to celebrate the Society's 150th anniversary. This event, with the theme of "Aerospace in Bedfordshire: Inspiring Future Generations", will take place as part of the Military Air Pageant at the Shuttleworth Collection, Old Warden, Bedford on Sunday 3 July 2016. Alongside various Bedfordshire aviation organisations, including the Aircraft Research Association, Blue Bear Research, Cranfield University and Lockheed Martin, BAHG will present a display (just for the one day) on the history and achievements of RAE Bedford, and its contribution to aeronautical advances. Admission to the pageant is by ticket only – see Shuttleworth web site for details. We hope to see some of you there.

RAE Bedford aircraft in the news Two former Bedford aircraft have featured in the news recently, Canberra WK163 and P1127 XP984.

The Vulcan to the Sky organisation has announced that they plan to restore Canberra WK163 to flying condition. WK163 operated at Bedford from 1976 until 1994, having transferred in from Pershore where it had been used on radar research from 1959. At Bedford, research continued on Infra-Red Line-Scan work and the aircraft was also used as a "skin target" for the Blue Fox radar and as a transponder target for Homing-Head projects. Extensive installation work was carried out in the late eighties (*see picture taken 28 August, 1991, Neg. A6569*). WK163 left Bedford when the airfield closed in March 1994 and moved to Farnborough prior to being sold to Classic Aviation operating from Coventry. An extensive piece about this aircraft was given in BAHG Newsletter Issue 16, October 2014.

P1127 XP984 was the 6th P1127 aircraft built and was the prototype for the Kestrel variant with the Pegasus 5 engine. XP984 operated at Bedford from Sept 1966 to Oct 1975. During this time, it took part in experiments to evaluate operations from restricted sites (picture left, *neg B2013D*). The Brooklands Museum is planning to restore the aircraft and we are helping with information about the aircraft's work at Bedford. Any recollections from people who worked with this aircraft would be welcome. Its flying career ended after an accident at Bedford on 31 Oct 1975, see picture right [*neg B4040C*], from which the pilot fortunately emerged with only minor injuries.

Vertical Take-Off & Landing (VTOL) Research at RAE Bedford The VTOL research vehicle officially known as the Rolls-Royce "Thrust Measuring Rig", but popularly called "The Flying Bedstead" for obvious reasons, transferred to RAE Bedford on 26 June 1956. This example, XJ314 (see picture at top), was one of the two built to explore some of the flight control challenges of vertical and hovering flight, and was the first jet-powered VTOL aircraft in the world. It's now in the Science Museum, London. The arrival of the Bedstead marked the start of a major research programme at Bedford on various aspects of VTOL that continued until closure of the establishment. Some aspects of this work have been described in previous issues, but it is informative to give a summary of the whole sequence.

The next VTOL research aircraft to arrive was the Short SC1. Short Brothers, a company with links to Bedford dating back to 1916, designing and building airships at Cardington, produced two SC1 Vertical Take-Off and Landing Aircraft for RAE (XG900 & XG905). XG905 made the world's first transition from wing-borne to jet-borne flight, at Thurleigh on 6 April 1960. Like the Bedstead, the SC1 electronic fly-by-wire flight control system was innovative and ranks as an important early step towards design maturity and regulatory confidence in the adoption of such systems by the UK.

XG900 is now in the Science Museum in London and XG905, which made its last flight, at Bedford, on 3 May 1973, is in a museum near Belfast.

In Feb 1965, VTOL research took a further step forward when prototype Hawker P1127 XP831 was flown to RAE Bedford by company test pilot Bill Bedford, to join the Aero flight fleet. A second P1127, XP976, followed soon after.

When the RAF decided to order the Harrier in 1965, following the tri-partite evaluation of the Kestrel by the UK, US and Germany, a key requirement was that the aircraft should be capable of operation from primitive sites, away from fixed runways. The feasibility of such operations was first attempted at RAE Bedford using a specially constructed "hole in the wood", located at the Twinwoods airfield. These trials were the first to feature a VTOL aircraft operating from a very restricted site *[Kestrel XS695 at Hole in Wood, March 1966 (B1874E)]*. The Harrier GR1 entered RAF service in 1969 and was first deployed to RAF Germany in 1970, where such dispersed sites were used.

During 1975/76, the VIFF project (Vectoring in Forward Flight) assessed the benefits of using thrust vectoring in air combat. Harrier GR1 XV277 flew in one-on-one air combat over the RAE tracking range at Aberporth, off the Welsh coast. One hundred recorded one-on-one combats, each lasting three minutes, against an RAE Hawker Hunter and an RAF English Electric Lightning, were flown. The fruits of this work were seen a few years later, in the Falklands conflict.

Also in the 1970s, before the Sea Harrier entered service with the Royal Navy, operational flying issues were explored in the flight simulator to establish autostabiliser functionality and the best flying technique for recovery to ships in poor weather conditions. In addition the HUD symbology for recovery was optimised for the task.

After RN officer, Lt. Cdr. D R Taylor RN, proposed the ski jump as a way of improving a Harrier's performance at sea, an experimental ski jump facility was built at RAE Bedford to assess the best ramp angle. The world's first launch of a Harrier VTOL aircraft from a ski-jump took place at Thurleigh on 5 Aug 1977. More than 500 launches were completed proving the technique and the ski-jump was adopted by the Royal Navy for Invincible class ships.

Following the support provided by RAE to the success of the Sea Harrier, further research plans were defined. RAE Bedford's two-seat Harrier XW175 was extensively re-engineered under contract at Cranfield in 1984 to enable the pilot in the rear seat to fly via a computer rather than by the usual controls. This enabled novel concepts for the control of a future generation VTOL aircraft to be assessed safely. After these modifications, the aircraft was known as the VAAC Harrier (**V**ectored Thrust **A**ircraft **A**dvanced Flight **C**ontrol). Several flight control concepts were evaluated. More modifications to the aircraft followed in 1994, to upgrade the control system to have full authority control in the lateral and directional axis, to introduce side stick controllers and to enhance the computing capability.

From the late 1980s the VAAC programme had been accepted as a major UK contribution to Joint UK-US ASTOVL Studies in support of a conceptual strike fighter (which evolved by 1995 into the highly ambitious Joint Strike Fighter, now known as the F-35). Following contract award to Lockheed Martin for the F-35 Lightning in 2001, XW175 became the joint UK/US flight test vehicle for the development of the fly-by-wire flight control system of the Short Take-Off & Vertical Landing (STOVL) variant (F-35B).

Using RAE Bedford's Advanced Flight Simulator, and the specially adapted two-seat VAAC Harrier XW175, research eliminated the complexity of flying VTOL aircraft in the hover and transition, a world first, by the use of electronic fly-by-wire and advanced flight control algorithms. Following extensive testing and demonstration with XW175, these algorithms are now being used for pilot control in the next generation US-UK Joint Strike Fighter (F-35B) VTOL aircraft for operation with the RAF and on RN Queen Elizabeth Class aircraft carriers.

BAHG Facebook The page, set up initially for the re-union in 2014, has recently been updated. It aims to allow members to keep in touch with ex RAE/DERA Bedford employees, as well as hearing various stories relating to the site. The BAHG Facebook page can be accessed by clicking on the Facebook symbol, which is found on the BAHG website's home page (www.bahg.org.uk). You do need to have a Facebook account.