Extracts from….
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**Rebecca, Eureka – homing in**

A group of us with an interest in technical subjects were having a discussion about wartime electronics equipment the other day when one of our number made the reference "…….and all that gubbins" when talking about some of the more obscure items of equipment that had been developed. It is not a phrase that I have heard for many years and it took me back to the training I received in the RAF on the Rebecca homing system. A few decades ago it was common for people to refer to items that were too complicated to explain in detail as "…all that gubbins", as a shorthand way of summarising it. Our corporal instructor at RAF Cosford injected considerable interest into the subject of Rebecca by first giving the origins of the phrase which, he explained, centred upon Major-General Sir Colin McVean Gubbins, who spent several years during WWII, first as Deputy and then as Director of the SOE, the Special Operations Executive. The instructor had now assured our full attention and he continued with his explanation. SOE, known privately as the Ministry of Ungentlemanly Warfare, funded, equipped and trained resistance workers in countries occupied by Axis forces and Gubbins worked tirelessly to ensure that their unusual equipment requirements were fulfilled. Items such as silent de Lisle .45 carbine rifles and the Welrod .32 and 9 mm pistols, miniature cameras, rubber stamps for the production of false documents, developments of the SIS B1 Mk7 which SOE adopted as the 'paraset' and B2 suitcase wireless sets were just a few of the items authorised by Gubbins for delivery to resistance workers. For SOE, one of the greatest difficulties in need of an urgent resolution was the safe and reliable delivery by air of equipment and personnel to resistance organisations operating in enemy-occupied territory. Aircraft dispatched to deliver supplies and drop off or pick up agents were frequently returning without completing their task due to poor visibility, navigational errors or enemy activity. By necessity, the delivery operations were undertaken under the cover of darkness and locating the dropping zones or small temporary airstrips accurately at night was frequently an epic feat of navigation. Pilots would endanger their aircraft, their crews and those on the ground by spending time in enemy airspace searching for the designated zones and could often attract the attention of ground and air defences in the area. In the early stages of these operations, ground operatives would light bonfires and make signals with lamps to mark their positions, but the longer these location aids were active the greater the risk of detection by the enemy. A much improved method of locating these remote areas was required. In 1941, Gubbins heard of a prototype aircraft homing beacon system being developed by 25 year old physicist Robert Hanbury-Brown at TRE, under the code names of Rebecca and Eureka. Hanbury-Brown had been identified as a rising star by Sir Henry Tizard who, in 1936, had recruited him to work on the Chain Home RDF system and later appointed him to his Tizzard Mission in Washington from 1942 to 1945.

After producing a working prototype of Hanbury-Brown's design, TRE passed the project to Murphy Radio for further refinement and contracted early production of the sets to the highly regarded Hacker brothers who, before the war, had achieved a considerable reputation for the quality of their domestic radio products using the trading name of Dynatron. The airborne Rebecca set transmitted a series of encoded 300 Watt short pulses using a quarter-wave vertical aerial which was usually installed immediately under the nose of the aircraft. The companion Eureka receiver was positioned on the ground at the drop or landing site from where a 12 W output transponder was triggered by the Rebecca signal to send a return signal to the aircraft on a separate frequency.

**An RAF Dakota with the starboard Rebecca aerial clearly seen just below the cockpit window**

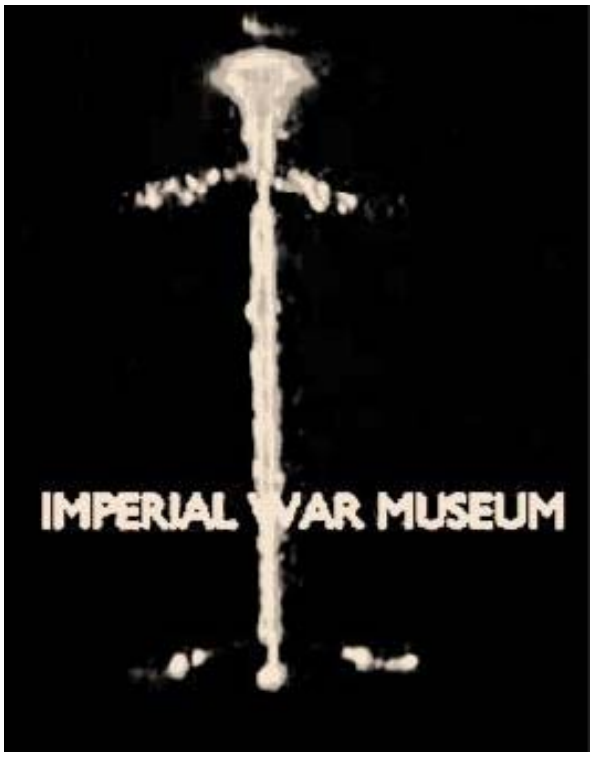
The Rebecca set in the aircraft measured the time lag between its own transmitted pulse and that received from the Eureka ground transponder to provide distance to target information on a CRT display with a vertical line calibrated in miles and varied in range by operator switch selection as the aircraft closed on the target location. A directional two element Yagi receive aerial was fitted to each side of the aircraft nose and the signals from each were displayed as lobes to the left and right hand side of the vertical display on the CRT, intersecting the vertical line display at the indicated calibration distance of the Eureka beacon from the aircraft. If the two side lobes were equal the aircraft was on a direct heading to the target, while an unequal left/right lobe display informed the pilot to change his heading by turning the aircraft in the direction of the larger lobe until lobe equilibrium was achieved.

Early airborne tests of Rebecca had found that the received signal from Eureka could be partially modulated by the aircraft propellers causing range errors and this was overcome by mounting the two aerials on the aircraft nose rather than on the outer underwings where, theoretically, they would have provided better heading discrimination. Operationally, the Rebecca/Eureka homing system worked at up to 100 miles distance and could achieve an accuracy of 200 yards on its approach. From the pilot's point of view, this was an excellent system

which enabled him to locate his drop zone or landing strip accurately, even in periods of poor visibility, complete his task as quickly as possible and return home. While it had many advantages for the reception party on the ground, they disliked the bulk and weight of the Eureka equipment which consisted of the transponder, fitted with an explosive charge, an aerial array and batteries for about 30 hours of operation, all weighing in at 112 pounds and presenting great difficulties for concealment and transportation.

Early Rebecca/Eureka systems operated on single duplex channels but were improved rapidly as more applications for the homing system were found. The MkII version had five channels spaced at 5 Mc/s intervals between 214 Mc/s and 234 Mc/s and listed as channels A to E. Radio company AC Cossor, the valve, CRT and radio manufacturer and builder of the Chain Home RDF receivers, was appointed to develop lighter equipment for easier transportation on the ground and for use in fighter aircraft and gliders. Cossor used their experience with thermionic valves to utilise the new and much smaller B7G based valves then entering service and applications for the system extended to paratroop drop zones, forward airfield location, aircraft carrier location, assault glider landing zone identification and even target location. Among troops arriving on the Normandy landing beaches in June 1944 were Royal Air Force ground crews equipped with mobile Eureka beacons mounted onto small three-quarter ton lorries containing batteries, generators and other support equipment. Their dangerous task was to establish a Eureka beacon at map co-ordinates designated to them by senior commanders, usually very close to front line activity, where they would act as beacons for photo-reconnaissance Mosquito aircraft operating with Rebecca sets modified to receive signals from two separate Eureka stations simultaneously. Because it utilised two ground beacons, this Rebecca/Eureka system was classed as 'R-Squared' equipment with a designation of Rebecca-H and Eureka-H. Identifying enemy dispositions accurately was crucial to securing worthwhile PR intelligence and, where possible, this was achieved by comparing the two Eureka signals with GEE position indicators, although often the GEE signals, which emanated from UK based stations, were easily jammed by the enemy.

Later versions of Rebecca/Eureka were developed as BABS, the Beam Approach Beacon Signal for airfield approach, and were ultimately adapted as the Mark X version used for in-flight refueling. The tanker aircraft was equipped with a Eureka transponder operating at around 1 GHz and the Rebecca-equipped customer aircraft could covertly home onto it without the necessity of using radar which could alert hostile defences. Rebecca/Eureka certainly made a major contribution to navigation, air safety and combined operations in WWII and went on to serve, in its various guises, for many years after the war.




**Rebecca display on board the aircraft, which is indicated at the base of the vertical line. Near the top is the received signal lobe from the Eureka transponder, which indicates range to target (range scale not visible) and direction. In this instance the pilot needs to turn slightly to port in order to correct his heading**

**Information sources:**

**VMARS Archive** – http://www.vmarsmanuals.co.uk/archive/ 271_AP2914B_Rebecca_Eureka_ARI5506.pdf The above link is for those with an interest in further reading on this equipment. The VMARS Archive has a 70 page Air Publication describing the full technical operation of Rebecca/Eureka MkII, its operating procedures and all that gubbins, including a reminder to set the explosive charge switches should you have to evacuate the aircraft in an emergency

**VMARS Website** – A 30-minute film classified "Most Secret" was produced by TRE and issued by the Air Ministry to help train aircrews and ground crews in the use of Rebecca/Eureka and can be viewed on the VMARS website at :http://www.vmars.org.uk/Film_Recordings under the heading of WWII Electronic & Countermeasures Warfare. The film is owned by the Imperial War Museum and may be used under a non-commercial licence

**World Wide Web** – A detailed account of the operational life of Eureka-H ground crews can be found online at http://www.rquirk.com/cdnradar/cor/chapter14.pdf. Eureka-H Radar Beacons – FR Hunt from documents released by WD and endorsed by Air Marshall A Coningham, AOC 2nd Tactical Air Force 5th June 1945