# EUREKA-H RADAR BEACONS

# IN

# WORLD WAR II

**Prepared by F.R. Hunt**

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# PREFACE

The requirement arose in late 1943 for a navigational system that would be easy to use by navigators of fast-flying Mosquito aircraft used in the night-time photographic reconnaissance role in the forthcoming North-West Europe operations. This need was met by the modification of the existing Rebecca interrogators used by aircraft in Transport and other Commands. This resulted in Rebecca-H equipments used in the aircraft of No.140 Squadron and Eureka-H radar transponder beacons employed on the ground. The initial four beacon crews began training in April of 1944, followed later by four more crews. The first two crews were operational in Normandy by the 2nd of July within shell-fire range of the Germans. From that time, the crews saw action until the end of hostilities in May of 1945.

# The Story of Eureka-H Radar Beacons

In order to fight successful or defensive battles, it is necessary to know the dispositions of the enemy armies. To obtain this information for the forthcoming invasion of Normandy, 2nd Tactical Air Force (TAF) had two wings of daytime fighter/reconnaissance aircraft* . In addition, 2nd TAF had a Headquarters Wing of reconnaissance aircraft for long-range daytime and night-time duties. 34Wing consisted of the following Royal Air Force squadrons; No.16, flying Spitfires, No. 69, flying Wellingtons, No.140, flying Mark XVI Mosquitoes, and a Meteorological Flight flying high altitude Spitfire IX's. Because of their speed, it was known that the Mosquito navigators would have difficulty in finding their photographic targets at night when visual clues of their position were non-existent. Furthermore, radar navigation aids based in England would probably be jammed, making them unavailable for use on the Continent. Therefore, a navigational system was devised using highly mobile radar beacons. In the early stages of the invasion with a narrow beachhead, it was often undesirable to have the technical site adjacent to the living site of the personnel. The radar van could be driven to the previously chosen site, the van oriented in the right direction, the antenna erected, and the power generators unloaded and the equipment placed operational by a two-man crew within 15 minutes. Reversing the procedure took even less time. The standard joke of the beacon crews was the recommendation to leave the vehicles with their noses pointing away from the front lines. When you saw the generals advancing to the rear, join them!

The Eureka-H beacons were mainly used by the Mosquitos, although the Wellingtons were also equipped with Rebecca. 140 Squadron began training with Rebecca-H equipment in February of 1944. The ground-based Eureka-H beacons used for these early trials were probably experimental equipment manned by radar personnel from the Wing.

The Rebecca-Eureka equipment had been originally designed for troop-carrying transport aircraft. The Rebecca equipment allowed these aircraft to "home" onto a portable Eureka beacon dropped with its crew by parachute. Since it was a pulse system, the range and direction of the aircraft from the beacon could be ascertained from the Rebecca's indicator in the aircraft. When the aircraft was at a suitable range from the beacon, the parachutists commenced dropping.

Both the airborne Rebecca-H and ground-based Eureka-H equipments for the photo-reconnaissance role were modified versions of the original Rebecca equipment. These units formed what is now called an "r-squared" navigational system. That is, the aircraft's ranges from two ground-based beacons were measured. The one ambiguous position permitted by the system was eliminated either by map reading (the ambiguous position was usually many miles from the true position) or by the use of GEE which the aircraft also carried.

*(*) Shores C.F. "2nd TAF", Osprey Publications, Reading Berks, England, 1970*

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Both airborne and ground-based equipments used identical transmitters and receivers which operated at 5 spot frequencies from 214 to 314 MHz. The airborne equipment transmitted 300 pulses per second on one of the frequencies. A few microseconds after receiving an aircraft's pulse, the ground-based beacon would transmit a similar pulse on one of the other spot frequencies. Although the replies were automatic, earphones were provided on the ground-based equipment to indicate to the operator that interrogation was occurring. In order to differentiate between the beacons, each beacon would automatically interrupt its replies once per minute. At that time, the equipment would code its reply pulses with a Morse character; in the case of 5320, the letter 'A' was transmitted.

The ground-based Eureka equipment was mounted in a 3/4 ton signals van with the antenna mounted on top. The antenna consisted of four vertical dipoles mounted in a vertical line. Behind the dipoles was a parabolical shaped reflector made of chicken-wire mounted on a pipe-frame, ten feet high, by 4.3 feet wide, by 1.2 feet deep. The array produced a horizontal beamwidth of 90 degrees. The antenna was permanently mounted on the roof but hinged so that it lay flat for transport. Power for equipment was provided by Douglas two-cylinder motorcycle engines driving electrical generators.

From a pre-flight briefing, the aircraft's navigator knew the ranges of the target from two beacons. Depending upon the geography of the area to be photographed, he would decide on which beacon he would use to fly at a constant distance. Using the Rebecca equipment, the navigator would direct the pilot to fly to a point on this constant range line. The pilot would then be directed to fly along this line until the display showed that he had reached the desired range from the second beacon. The navigator would then press the button to initiate the release of flares and the start of photography.

Each beacon crew consisted of a Radar Mechanic (RM), (Sergeant or Corporal, NCO i/c), another RM, a Radar Operator (RO), Motor Transport Mechanic (MTM), and a Dispatch Rider (DR). Their personal effects plus camping gear were carried in a 30-cwt truck. When on operations, a Wireless Observer Unit (WOU) was attached for wireless communications to headquarters. This unit consisted of a Corporal Ground Observer (GO), NCO i/c, plus two other GOs, and two Wireless Operators (WO). In its normal operation, the WOU communicated the position of any enemy aircraft observed in the vicinity to the Group Control Center (GCC) where it was correlated with radar plots. Their equipment was carried in a 3-ton truck.

The RMs for the first four beacons assembled at 34 Wing, then based at RAF Hartford Bridge, on March 27th, 1944. Most were from disbanded Light Warning (LW) crews that had been in existence since early 1943, who were experienced in mobile radar operations. Four days later, they moved to the Telecommunications Research Establishment at Malvern. They were billeted in civilian homes in West Malvern, which entailed a hike over the Malvern Hills for breakfast each morning. This was alleviated by a pub crawl on the circuitous route around the base of the hills on the return trip in the evening. At Malvern, they took a two- week course on the circuitry and operation of the Eureka-H beacon.

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The RMs left Malvern on the 17th of April for RAF Renscombe Downs in Dorset. There, they met the ROs and MTMs who were also ex-members of LWs. Most of the personnel had been there previously to take LW courses and initial Combined Operations Training. Here the beacon crews repeated much that had been learned before, and also became proficient in driving vehicles. At the end of the course, the personnel were divided into four crews, Radar and Mobile Signal Units 5320 to 5323. The author, LAC F. R. Hunt (Port Hope, Ontario), and Sgt. A.H. Barnett (Toronto) assigned to 5320 and 5321 respectively, were the only Canadians involved with the first four crews.

The crews left Renscombe Downs and travelled to the Supply Depot at Cardington. Here, the Eureka-H technical vehicle, the second vehicle, motorcycle and camping gear were issued. The Dispatch Riders also joined the units here.

On May 8th, the crews joined 83 GCC, then camped on Walderton Downs near Chichester. 83 GCC was to be the headquarters of the first four beacons until the end of the year. The officer, 2i/c of the signals and radar section of this unit was a F/L Gibson (Winnipeg). The other four beacons, 5324-5327 followed the itinerary of the first four but a few weeks later. They subsequently joined 84 GCC. The only Canadians with these crews were Cpl. Trudgeon and LAC Riley (hometowns unknown) of 5327.

On May 12th, the first four crews, each accompanied by a WOU, left GCC on a 9-day exercise. The individual crews made a move every other day to a new site in Southern England and operated every night. At the end of the exercise, the crews met at 34 Wing HQ, now situated at RAF Northolt near London. A critique of the exercise was carried out and then 5320 and 5321 returned to the GCC at Walderton Downs. The other two crews went on a further exercise to determine if the equipment could be used for accurate bombing. It was decided that other equipments, such as mobile Oboe, were better adapted to the role.

On June 6, 1944, 5320 and 5321 moved to a site near Havant, in the south of England, as the rear echelon of 83 GCC was moved to a vehicle waterproofing station in preparation for rejoining the forward echelon in Normandy. On June 17, the two crews moved to RAF, Old Sarum, for waterproofing of their vehicles. They moved east of London, and camped there for a few days to the sound of the first buzz bombs. Then they loaded their equipment aboard the Liberty ship Fort Biloxi and sailed for Normandy.

At Arromanches on the 28th of June, the two crews and their vehicles were transferred to an LCT (Landing Craft Tank). It was intended that we should make a wet landing and the craft beached. However, when the bow ramp was dropped and a naval rating measured the depth of water, it was greater than ten feet deep. The craft was backed out, and at the same time an empty spot at the dock became available. The craft then tied up to the dock and we made our way ashore dryshod. The beacons then moved on to the GCC site near Bazenville.

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On the 2nd of July, the two beacons made their way to the first operational sites--5320 on the southern slope of a hill facing Caen and 5321 north of St. Lo in the American sector. WOU posts already operating in the vicinity were assigned for communication purposes. The one operating with 5320 was on the northern slope of the hill about 2 kms distant from the beacon. It had been ordered to camp at a crossroads in order to facilitate GCC personnel finding it. The next night, the two technical vehicles were faced north for practice operations by 140 Squadron over the Channel. The following night, the trucks were faced south and actual operations began on a nightly basis.

Both beacons were subjected to enemy artillery fire, particularly 5320. During its stay near Caen, the front lines were initially as close as 4 kms. By the 23rd of July, the Allies had shoved the Germans back to a line about 6 kms from 5320's site. In the mid-afternoon of that day, some light shelling of the site occurred and later shifted in the direction of the WOU post. After the shell firing was finished, Cpl. Merriman, NCO i/c of 5320, walked back to the WOU post to check on it. He returned very quickly with news that it had been hit by the very first shell just as they were sitting down to afternoon tea. Two of its members were killed, two others severely wounded and the last member had a scratch on the head. Contact was made with GCC and 5320 returned there for a rest.

Meanwhile, 5322 had landed in Normandy and it was sent to a somewhat safer site near Caen. In July, 140 Squadron's Mosquitos completed 88 night-time sorties with 80 being successful.

On the 14th of August, 5320 was again in operation near Tessy-sur-Vire in the American sector with another WOU post attached. Meanwhile, 5323 had also landed and began operations.

Operations continued until soon after the closing of the Falaise Gap. On the 6th of September, the four beacons moved to the site of 83 GCC's rear echelon near Evreux. With the latter unit, the beacons moved north to a site near Brussels. This entailed driving through a wildly cheering Saturday afternoon crowd in that city which had been liberated the previous Sunday.

On the 18th of September, the crews left for new operational sites, 5320 near Renaix and 5321 near Louvain, covering the Schelde operations. 5322 and 5323 went further east to Gheel and Liège. Here they covered the operation in support of the Arnhem/Nijmegen airborne drops. For their stay here, 5320 had a quiet period although operations were carried out every night. On the 2nd of November, with the Schelde operations virtually complete, 5320 moved to a site near the Gilze-Rijen airfield in southern Holland. Here, they provided beacon coverage north of the Maas river for part of the winter of 1944-45.

34 Wing moved to Melsbroek on the outskirts of Brussels in late September, where it was to remain until April of the following year. In early January, 1945, the administration of the crews was transferred to 34 Wing from the GCCs. At the same time the beacons lost their WOU posts but retained the two operators and their wireless equipment. Each crew was also assigned a second radar operator.

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During November and December, 5321 operated in the area of Louvain, Liège and Bree covering the whole of von Runstedt's Ardennes offensive*. Enemy air activity increased, the beacon was continually bombed and two of the vehicles were damaged. In early January, they moved to a site in Holland near Aachen.

Sgt. Trudgeon's 5327 beacon started out, as many of the other beacons had, at a site near Caen in late August*. Here, they were subjected to the usual shelling that other beacons had suffered. In late September, they arrived near Grosbeek in the middle of the field where airborne troops had dropped in mid-month. The site was conspicuous by the large number of unburied bodies. It appears that they were in the middle of a huge German mine-field. The bodies could not be buried until the mines were cleared. Following the Allied advances in the spring, 5327 ended up in Appeldorn until recalled to Wing HQ in May.

On the 1st of January, 1945, the airfield at Gilze-Rijen was attacked by 16 German aircraft. The crew of 5320, sleeping in a nearby Dutch farmhouse, were rudely awakened by the sound. Rushing out in their pyjamas, they fired on the aircraft with rifles. Whether any aircraft brought down by ground fire could be claimed by the crew is unknown. After the commotion died down, they assisted some Dutch civilians and two Canadian Army privates who had been wounded during the strafing of the nearby road. The beacon's own vehicles had been parked in a barn and consequently suffered no damage.

On the 23rd of January, 5320 was taken off operations. After a short leave in England, the crew returned to their old site near Renaix. There, they operated during the daytime to provide practice and air-testing of Rebecca equipment for 140 Squadron's Mosquitos. On the 24th of March, an order arrived to face the technical van to the west, an unusual direction at that time. The author had the first watch that day. About 9 AM, the beacon's earphones began to emit a queer sound. Usually a single musical tone of about 300 Hz was heard when the beacon was being interrogated by a single aircraft. This time, it was obvious that the equipment was either unserviceable or being interrogated by a large number of aircraft. Quick checks showed that the equipment was probably serviceable. In about 15 minutes, the beacon was overflown by a group of several hundred Dakotas. We learned later that this was part of the 6th British Airborne Division bound for landing sites east of the Rhine and north of Wesel. This was the last time that 5320 was to take part in operations against the enemy.

Sgt. Barnett's 5321 crew moved from near Aachen to near Munchen Gladback in March*. Early in April, they moved on to Ameke near Hamm; then to Vilsen near Bremen where they remained until the recall to Wing HQ. 5322 crossed the Rhine at Xanten two days after a pontoon bridge had been

(*) Martin, C.A., “Front Line Radar”, Joh. Luijk, Eindhoven, Holland, 1945

installed there. They continued east into Germany and finally ended up at Leppin on the river Elbe. At that time, they were the most forward RAF Unit in Germany. Crews 5323, 5325, and 5326 also operated in Germany before the final surrender in May. Beacon 5326 actually ended up back in Holland. Their final operating site was near Groningen, where they provided coverage for the mopping-up operations of the Canadian Army.

In April, 5320 moved to a site near Tongeren in eastern Belgium and again engaged in daytime practice operations. On May 24th, all beacons returned to 34 Wing HQ, now situated on the Eindhoven airfield. The author is unsure when the beacons were officially disbanded. They remained at Eindhoven as units for the summer. Sgt. Barnett left at the end of July on repatriation to Canada. In mid-August, the beacon crews left 34 Wing without their vehicles and equipment. Travelling by train and ship, they arrived at RAF Thame, near Oxford on the 21st of August. After two weeks' leave, the crews reassembled at Thame. Piece-meal postings then ensued with the author being posted to repat depot at Torquay on the 15th of September, thus ending an experience in front- line radar.

# APPENDIX "A"
# to
# EUREKA - H BEACON

From: Main Headquarters, Second Tactical Air Force.

To: Headquarters, No. 34 Wing.

Date: 8th June, 1945.

Ref: 2TAF/30424/Air

**Eureka-H Beacons**

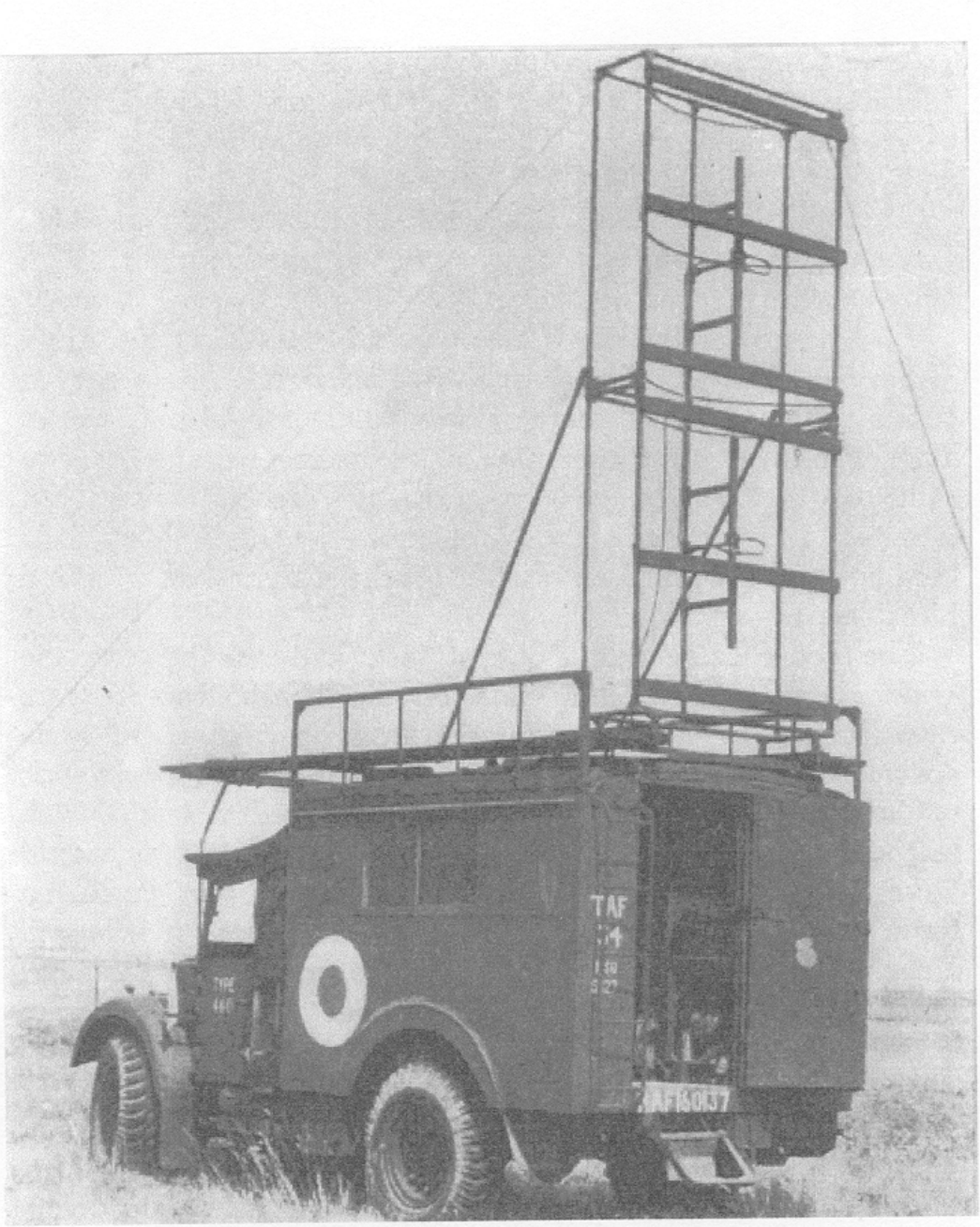
1. Second T.A.F. has been the first, and is likely to be the last user of the Eureka/Rebecca H system. It has been in use throughout the campaign in North-Western Europe from the early days of the invasion up to the cessation of hostilities.

2. During the entire campaign, there has been Eureka-H cover over substantially the whole Army operational area at all times. To achieve this, it has been necessary for beacons to move often for long distances and at short notice.

3. The service given by Eureka-H beacons has been exemplary. This has only been so because of the keeness and efficiency of the crews. These small units have often worked under uncomfortable conditions, sometimes well within shell fire range of the enemy. The work itself has not been spectacular, but the obtaining of photographs by night has been a vital requirement, and to a very large extent it could not have been done without the aid of Eureka-H beacons.

4. I wish my congratulations and thanks passed to all members of Eureka-H crews on the excellence of the work they have done.

(signed)
A. Coningham,
Air Marshal,
Air Officer Commanding-in-Chief,
Second Tactical Air Force.




**EUREKA-H BEACON VAN**

**"READY FOR ACTION"**