Bombs on Target – Part IV

The Telecommunications Research Establishment (TRE) at Swanage, implemented the system. The initial experimental systems started in June 1940. By July 1940 it was expected that the system would operate over ranges of about 100 miles (160 km), based on the widely held belief within the UK radio engineering establishment that the 30MHz short wave signals would have relatively short range. It was believed this would be very useful as an aid for short-range navigation to the airport, as well as helping bombers form up after launch at a pre-arranged location. Additionally, after flying to altitude the bombers could use the GEE fix to calculate the winds aloft, allowing more accurate dead reckoning fixes after the aircraft passed out of GEE range. However, it was found, to everyone's delight, that the system was usable to at least 300 miles (480km) at altitudes of 10,000 feet (3.0km). On 19 October they made a fix at 110 miles at only 5,000 feet. This discovery of GEE's extended range arrived at a pivotal point in the RAF's bombing campaign. For large, fixed targets, like the cities that were attacked at night, GEE offered sufficient accuracy to be used as an aiming reference without the need to use a bombsight or other external reference.

While a debate over the morality of "city busting" raged, Bomber Command dramatically lowered their sortie rate, awaiting the rebuilding of the force with the newly arriving 4-engine "heavies" such as the Halifax and Lancaster, and the deployment of GEE. The two, combined, would offer the accuracy and weight of bombs required. Efforts to test and deploy GEE became a high priority. Initial availability of GEE devices was limited, so the idea of a smaller GEE equipped Pathfinder force was adopted. The Germans had demonstrated this idea in their early night raids against England. The RAF Pathfinders would, using GEE, locate the targets and then drop flares or incendiary bombs to start fires that would provide an aiming point for following bombers attacking in night-long bomber streams.

The construction of GEE stations began in mid-1941. As the operational system was to be used over a much wider area, the transmitters of a single station had to be located farther apart. The single-transmitter, multiple-antenna solution of the original proposal was no longer appropriate. Instead, a new system using individual transmitters at each of the stations was installed. One of the stations would periodically send out its signal based on a timer. The other stations would be equipped with receivers listening for the signal arriving from the control station. When they received the signal, they would send out their own broadcast. This would keep all the stations in sync, without the need for a wire between them. Stations with a central "master" and three "slaves" about 80 miles (130km) distant and arranged roughly 120 degrees apart, formed a large "Y" layout. A collection of such stations was known as a chain.

The concept underwent a series of operational tests using handcrafted GEE sets referred to as GEE Boxes. In August 1941, GEE Boxes were ordered into production. By March 1942, GEE went operational. Periodic German jamming was encountered five months later, but it was not until 1943 that it became worrisome. GEE became so useful, that a non-working GEE set would ground an aircraft. After, the invasion of France in 1944, mobile GEE stations were deployed to extend the limiting 300 mile range farther as the Germans retreated.

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In 1944, GEE Boxes were installed in 8th Air Force bombers. The installation in a B-17 or B-24 was on the left side of the navigator's table. With minimal training, the navigator could rapidly become proficient in its use. At the user-level the GEE Box was user friendly, required a minimum of operator adjustments, and displayed on the cathode ray tube both station pulses simultaneously. The operator, dead reckoned from a previous fix and forecast the next expected future position. As these were plotted on the GEE Chart, he selected and dialed in two forecast values: one for rate and one for course. He than aligned the left edge of each received pulse with the forecast pulse values on the cathode ray tube display, thereby adjusting the dial settings. At this point he captured the adjusted values on the dials. These adjusted settings were then plotted as Lines of Position (LOP's) on the GEE charts. Where LOPs intersected was the aircraft's position, i.e. a fix at the time of "capture." This procedure was repeated as the aircraft made its way along the mission track, and the navigator continued to DR ahead, repeating the fix, using DR procedure. When GEE was used in bomb aiming, such as in a Pathfinder mission, the navigator was given the precise LOP values of the two stations being used to mark the release point and then navigated to that point using a series of DR and GEE fixes.

One example of its potential was that before and during the Invasion of France in 1944, a special GEE chain was installed for use of Allied Forces in the invasion area extending outward from the beaches, This chain was used by both naval and air forces. In the case of 8th Air Force "Lead" Crews, the GEE readouts were harmonized with the aircraft radar and the Norden bombsight. This permitted highly accurate GEE fixes when attacking targets in support of the invasion troops. GEE was also used as a navigational tool by invasion naval vessels operating in the channels leading to and from the beaches. GEE Boxes were installed on the ships allowing them to better transit the waters off the beach and to off load troops and material at briefed landing and off-load areas.