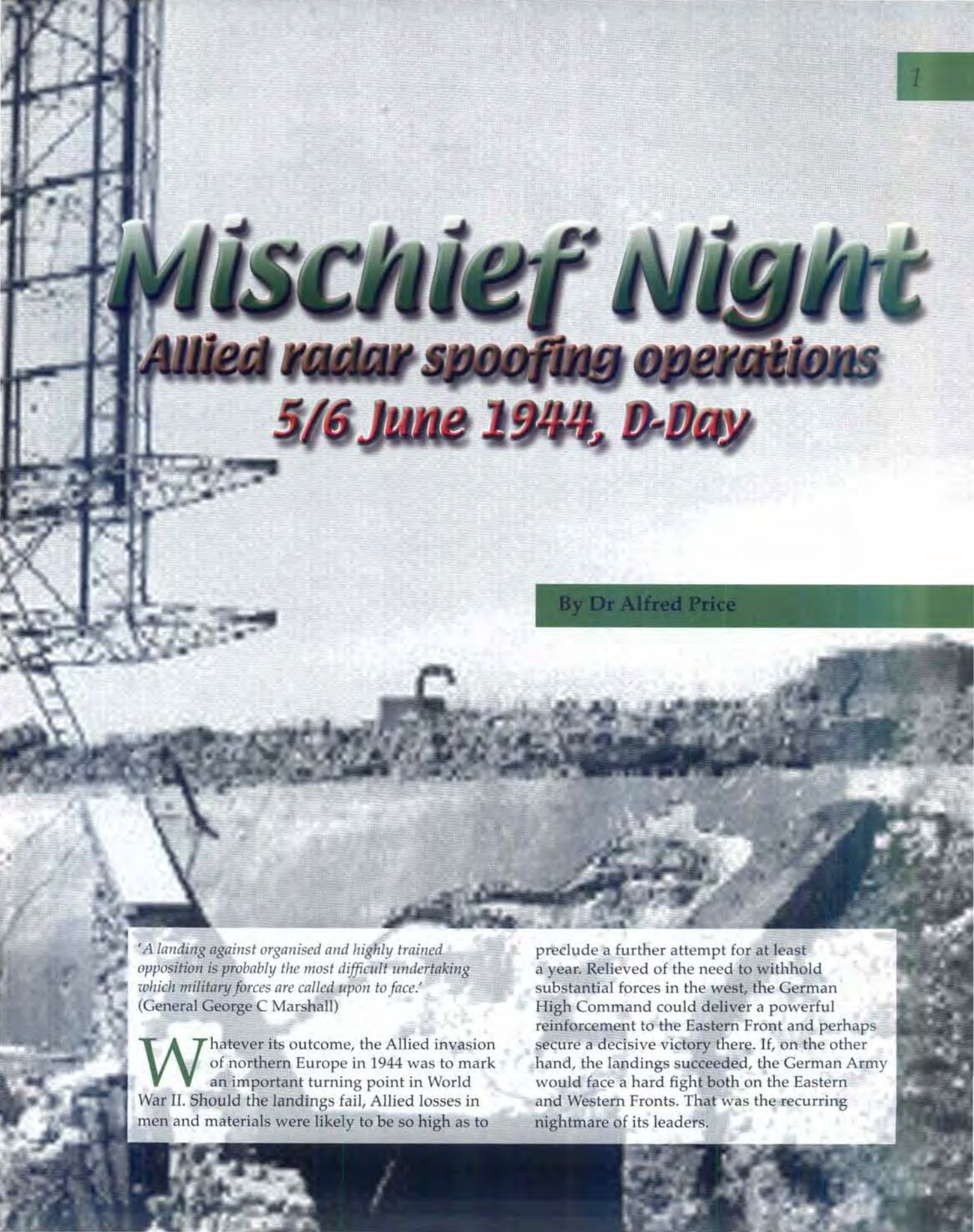
Mischief Night

Allied radar spoofing operations 5/6 June 1944, D-Day

By Dr Alfred Price



'A landing against organised and highly trained opposition is probably the most difficult undertaking which military forces are called upon to face.'
(General George C Marshall)

Whatever its outcome, the Allied invasion of northern Europe in 1944 was to mark an important turning point in World War II. Should the landings fail, Allied losses in men and materials were likely to be so high as to preclude a further attempt for at least a year. Relieved of the need to withhold substantial forces in the west, the German High Command could deliver a powerful reinforcement to the Eastern Front and perhaps secure a decisive victory there. If, on the other hand, the landings succeeded, the German Army would face a hard fight both on the Eastern and Western Fronts. That was the recurring nightmare of its leaders.

Giant Wuerzburg German defence radar

By picking up and decoding the German radio reports of the aircraft tracks, and back-plotting the distances and bearings given by the radar stations, Allied intelligence officers located several stations

Detailed planning for the invasion, Operation OVERLORD, began late in 1943. Soon afterwards tentative discussions began on the possible use of radio countermeasures to support the operation. The first expert in this field to become involved was Dr (later Sir Robert) Cockburn, head of the countermeasures section at the Telecommunications Research Establishment at Malvern. Together with the US ABL-15 countermeasures team co-located with it at Malvern, he began work to prepare the countermeasures plan to support the invasion. As with most aspects of OVERLORD, there was close integration between the British and the American efforts at all levels.[1]

By the late spring of 1944 the Luftwaffe fighter force had been so depleted during the hard-fought battles over Germany itself that Allied air superiority over the landing area was assured. Nevertheless, it was vitally important that the remaining German land, sea and air forces be permitted few opportunities to engage the troops as they waded ashore during the initial stage of the landings. The plan for the countermeasures operation, supporting OVERLORD, had the following aims:[2]

■ To prevent the enemy obtaining early warning of, and accurate plots on, approaching surface forces.

Having located the radar stations, knocking them out was no easy task . . . The specialised task of destroying these targets was assigned to Spitfire and Typhoon squadrons of the mainly British 2nd Tactical Air Force

Four underwing rockets aboard an RAF Typhoon

■ To prevent enemy coastal batteries from using radar-controlled gunfire against surface forces.

■ To support airborne operations by:

1. Reducing and confusing the enemy's early warning system, thus delaying both the arrival of fighters amongst and alerting of the threatened dropping zones.

2. Interfering with enemy fighter control R/T, thus affecting both the movement of night fighters into the area of operations and the vectoring of intercepting fighters.

3. Producing diversionary threats and thereby dividing the enemy's available fighter effort.

■ To delay the movement of enemy reserve ground forces by producing threats of apparent assaults, both airborne and seaborne.

Destruction of the defenders' radar infrastructure

To reduce the difficulties of jamming and spoofing the German radar network along the Channel coast, the first priority was to destroy as many as possible of the ground installations. The target was formidable: as part of Hitler's West Wall, there were radar stations positioned at roughly 10 mile intervals along the coast from Ostend to Cherbourg, each with an average of three radars.[3] These stations were equipped with the menagerie of German ground radar systems: Freya, Mammut and Wassermann early warning radars, Seetakt ship search and fire control radars, Giant and small Wuerzburg radars for fighter and flak control.

It was important that the softening-up operations should give no hint of where the invasion was to take place. To that end, for each radar target attacked in the area of the intended invasion, at least two were to be attacked in areas outside it.

For their success, the air attacks on German radar targets would depend on the accuracy of intelligence information on their locations. By the spring of 1944, Dr R V Jones's Scientific Intelligence department at the Air Ministry had assembled a detailed picture of the German radar network. But this picture had to be updated continually since radar sets, particularly the mobile Freya and Wuerzburg equipments, could be moved quickly to a new site and be operational within a few hours of their arrival.[4]

To assist in plotting the radars, the Telecommunications Research Establishment produced a special ground direction finder code-named 'Ping Pong' able to determine the bearing of a radar transmitter to within a quarter of a degree. From widely separated points across the south of England, the three Ping Pong equipments took bearings on enemy radars along the north coast of France.[5] Triangulation of the bearings gave approximate positions of the stations, which were then refined by photographic reconnaissance of the area.

Further help in locating German radars came from decoding radio reports on the movements of Allied aircraft, broadcast by the stations. As part of a long running operation code-named OCCULIST, Allied reconnaissance aircraft made carefully planned flights over occupied Europe, photographing the ground beneath to provide an accurate record of their tracks. By picking up and decoding the German radio reports of the aircraft tracks, and back-plotting the distances and bearings given by the radar stations, Allied intelligence officers located several stations.[6]

Having located the radar stations, knocking them out was no easy task. These small pinpoint targets were usually well protected by 20 mm and 37 mm anti-aircraft guns. The specialised task of destroying these targets was assigned to Spitfire and Typhoon squadrons of the mainly British 2nd Tactical Air Force. The anti-radar operations began on the morning of 16 March 1944,[7] when 12 Typhoons of No 198 Squadron set about the Wassermann early warning radar station near Ostend on the Belgian coast. During the initial attack four Typhoons attacked the radar with rockets and cannon, while the other eight strafed flak emplacements surrounding the main target. As the fighter-bombers left the target the 130-foot high antenna tower remained upright, so that afternoon the fighter-bombers returned. More

rockets hit the structure, but though battered the tower remained standing. At first it seemed that the radar had survived the attack, but that was not the case, for the Achilles heel of the Wassermann lay in the mechanism to rotate the aerial. The aerial was attached to a rotating sleeve, which turned on a fixed vertical cylinder. The rocket damage to the sleeve prevented it from rotating, and the aerial array could be lowered to the ground only if it faced in a certain direction. With the aerial tower now rigidly locked in the vertical position, German engineers had to dismantle the entire structure before they could commence repair work. The Ostend Wassermann would still be off the air in the following June when the invasion began.[8] Other types of radar suffered similar difficulties after being attacked from the air.

Meeting potential threats

By this stage of the war the Allied intelligence services were gaining such a wealth of information from decrypted enemy ground-to-ground transmissions that communications jamming was permitted only in exceptional circumstances. Yet there was a need to have such a capability, in case the land battle entered a critical phase and such jamming might swing the balance. During 1943, the US Radio Research Laboratory (RRL) at Harvard designed and built a range of communications jammers to cover the frequencies used by the German aircraft and tank radios. Two of these jammers, the airborne ART-3 Jackal and the ground MRT-1, went into limited production. The former proved all too effective during tests at Wright Field, Ohio, however. The officer in charge of the test, Lieutenant Colonel George Haller, recalled:

'During the lead up to the invasion we conducted tests with a new type of communications jammer, the ART-3 Jackal, a frequency modulated device to jam the German tank communications on the 27 to 33 MHz band. What we did not realise, however, was that the radios used by some Ohio police departments were using the same frequency as the German Panzers. One afternoon during a test of our airborne jamming of these tank frequencies to determine its effectiveness, there was a serious bank robbery in one of the small towns near our base. The robbers were able to make their escape due to our jamming of the police radios. The FBI soon figured out what the problem was and our laboratory was subjected to an investigation to see if there was any connection between us and the robbers. Fortunately we were found to be clean.'[9]

The MRT-1, code-named 'Elephant Cigar' and produced by the RRL, was by far the most powerful communications jammer built during World War II. It covered frequencies in the 38 to 52 MHz band, and radiated 50 kW from a large directional aerial mounted on a 105-foot high tower.[10] The jammer arrived in England in March 1944 and Royal Air Force technicians assembled it at a site near Brighton. Technicians completed the assembly of the transmitter components during May 1944, but completion of the aerial array had to wait until the invasion began. The directional aerial needed to point towards Normandy, and had a German reconnaissance aircraft photographed the structure beforehand this might have betrayed the planned invasion area.[11]

To cover the flanks of the seaborne invasion, British and US airborne troops were to carry out a large-scale parachute and glider assault at night. The leading aircraft were to drop pathfinder teams, who would erect 'Eureka' radar transponder beacons to assist follow-up transport aircraft to locate the dropping zones. If the Luftwaffe reacted swiftly and sent aircraft to jam or spoof the Eureka transponders that could seriously disrupt the airborne landings. To guard against this possibility, TRE engineers fitted four Mosquito night fighters with modified 'Lucero' air-to-air homing equipment to enable them to home on and destroy aircraft carrying such jammers.[12]

The ghost fleets

While the systematic destruction of the German radar network in France and Belgium ran its course, Dr Cockburn and his team at the TRE were putting the finishing touches one of the most elaborate pieces of electronic spoofery ever used: the simulation on radar of two huge ghost 'fleets', to divert attention away from the main Allied landing areas. Obviously, the simplest way to achieve this aim would be to use a large number of full-sized ships. But the invasion stretched Allied shipping resources to the utmost, and no large

ships could be spared for this purpose. Cockburn worked out a method of producing a huge radar echo, similar to that from a large assembly of ships, but using no real ships. By dropping Window (lengths of metal foil) from aircraft flying carefully arranged tracks, he hoped to erect an enormous radar reflector covering an area 16 by 16 miles or 256 square miles.[13]

The most important German coast-watching radar was the Seetakt operating in the 370 MHz band, and Cockburn planned his ghost 'fleet' spoof primarily against that system; he hoped it would also prove successful against other German radars, however. The beam width of Seetakt was 15°, so at a distance of 10 miles from the radar the beam was just over two miles wide. Allowing a margin for error, the plan called for Window clouds within two miles of each other along the frontage of the 'fleet' to produce a continuous 'blip' with no gaps on the Seetakt screen. The pulse width of Seetakt was three microseconds, which meant that the set could not discriminate between objects less than 520 yards apart in range. So to produce a continuous 'blip' on the radars in range, the Window clouds had to be closer than that. The bombers releasing the Window would fly at 180 mph, three miles per minute. Dropping Window at 12 bundles per minute would result in one bundle per 440 yards, sufficient for that purpose.[14]

Altogether, a full ghost 'fleet' operation required eight aircraft, split into two waves. The first wave of four would fly in line abreast with two miles between aircraft, and eight miles behind them would come the second wave in a similar formation. To simulate the advance of the 'fleet', the two waves of aircraft would fly a series of oblong 'race-rack' patterns, maintaining this formation, each oblong measuring eight miles by two. Each orbit would take 7 minutes, and at the end of each the formation was to move forward one mile. That would give a rate of advance for the formation — and therefore of the ghost 'fleet' — of 8 knots and make it look plausibly like an advancing assembly of ships. To add realism to the spoof, other aircraft would orbit over the English Channel radiating jamming on the German early warning radar frequencies. The positions of these orbits would be far enough from the German radars, so their operators to discern the fake 'invasion fleet' through the blanket of jamming.[15]

During May 1944 Cockburn ran a ghost 'fleet' towards captured German Seetakt, Freya and Wuerzburg radars set up on cliffs overlooking the Firth of Forth in Scotland: the spoof worked effectively against all of them. In this case the radar operators knew they were seeing a simulated invasion fleet, however. The next stage was to test the spoof against radar operators who had not been told what to expect. Eight bombers flew a ghost 'fleet' against a British Type 11 radar — the nearest equivalent to the Giant Wuerzburg — situated at Flamborough Head on the Yorkshire coast. The unsuspecting operators reported the echoes on their screens as having come from a very large convoy indeed — far larger than any they had seen before. Now Cockburn and his team could be reasonably confident that the spoof stood a good chance of working against German radar operators.[16]

Shortly before the invasion Cockburn obtained the use of an additional force to assist with his spoofs: four high speed air-sea rescue launches and 14 smaller naval launches, that were not required for other tasks on the morning of the invasion. To add realism to the ghost 'fleets', TRE engineers fitted the rescue launches with 'Moonshine' repeaters tuned to the 550 MHz Hohentwiel radar carried by German maritime patrol aircraft. Each launch was also to tow a float flying a 'Filbert': a 29-foot-long naval barrage balloon with a 9-foot diameter radar reflector mounted inside the envelope to produce a radar echo similar to that from a large ship. In addition to towing the floats, the naval launches were each to fly one 'Filbert' from their hulls.[17]

The carefully planned and rehearsed radar spoof operation had a major weakness, however, as critics of the scheme were quick to point out. 'What will happen,' they asked, 'if the Germans sent reconnaissance aircraft into the area and their crews saw with their eyes there is no invasion fleet?' Cockburn told this writer his standard reply to such a question:

The larger spoof, Operations TAXABLE, employed eight Lancaster bombers of No 617 Squadron and made for a point east of Le Havre. To reduce the chances of equipment failure each aircraft carried two GEE equipments, as well as two navigators and four men to dispense the Window

'Imagine the scene: a frightened under-trained young conscript radar operator sees the 'ghost' fleet on his screen and reports it to his headquarters as the long-expected enemy invasion force; so do his colleagues at other radar stations along the coast. Soon there appears a nice broad arrow on the situation map at the headquarters: the 'ghost' fleet is now a military fact. If aircraft were then to fly into the area and report it clear of ships, would their reports be believed? Probably not. The operation was to take place at night and the aircraft might be far off their intended tracks. Once a broad arrow representing an enemy attack appears on the situation map at a military headquarters, it is a military fact and it takes a lot to remove it.'[18]

It would remain to be seen whether Cockburn's prognosis would be proved correct, 'on the night'.

Destruction of the radars

The Typhoons and Spitfires had done well their

task of destroying the radar stations. By the evening of 5 June, seven long-range early warning radar sites had been put out of action, including all six of those to the west of Boulogne. Following the action Air Chief Marshal Trafford Leigh-Mallory, C-in-C of the Allied Expeditionary Air Force Commander, was able to report:

'In the vital period between 0100 and 0400 hours when the assault Armada was nearing the beaches, only nine radar installations were in operation and during the whole night, the number of stations active in the Neptune area was only 18 out of the normal 92. No station between Le Havre and Barfleur [on the north eastern tip of the Cotentin Peninsula] was heard operating.'[19]

With the 'softening up' phase complete, the jamming and spoofing phases could go ahead. In the hours preceding the invasion, the two ghost armadas 'set sail'. The larger spoof, Operations TAXABLE, employed eight Lancaster bombers of No 617 Squadron and made for a point east of Le Havre. To reduce the chances of equipment failure each aircraft carried two GEE equipments, as well as two navigators and four men to dispense the Window. The smaller of the two spoofs — Operation GLIMMER — was flown by six Stirling bombers of No 218 Squadron that headed for a point south of Boulogne. Each aircraft carried a GEE and a GEE-H navigational system, with three navigators to monitor the intricate flying patterns. The Stirlings also carried four men to dispense the Window.[20]

Orbiting to the north of the real and ghost invasion fleets were four B-17 Flying Fortresses of the US 803rd Bombardment Squadron and 16 Stirlings of the No 199 Squadron RAF. These aircraft put up a screen of jamming to cover the various operations, with the jamming deliberately thin to the east to allow the German operators to observe the TAXABLE and GLIMMER spoofs.[21]

Beneath the orbiting aircraft and their falling clouds of Window, the small flotilla of launches headed south into the choppy sea with their ungainly 'Filbert' balloons trailing downwind. Cockburn was full of praise for the Moonshine operators on the boats that night:

'The Moonshine operators came from an American Army signals unit. These men had arrived from Iceland too late to be brigaded into the main invasion, so they were given to us. They were absolutely first class. They hadn't seen any war, they were tickled pink at the idea of taking part and were keen as mustard. The launches ran in — can you imagine it, 6 knots in such a craft in a Force 6 sea? The Moonshine operators were seasick to a man but they operated their equipment magnificently.'[22]

Just after midnight the Moonshine operator in a GLIMMER launch observed signals from German airborne radar on his cathode ray tube. He tuned in his transmitter, and the game was on. During the next two hours he logged signals from eight separate aircraft and 'Moonshined' seven of them: the eighth was of too short a duration. Fifty miles to the west the Moonshine operators with the TAXABLE force also picked up German aircraft radar transmissions, which they too returned 'with interest'.[23]

When the ghost 'fleets' arrived at their stop lines some ten miles off the coast of France, the launches anchored the floats with the 'Filbert' balloons. Then they laid a smokescreen and broadcast over loudspeakers recordings of the squeals, rattles and splashes germane to a large number of seagoing ships dropping anchor.[24] Their deception task complete, the boats had a hasty withdrawal to get clear before the expected reaction from the defenders.

The spoof airborne invasion

While the TAXABLE and GLIMMER 'fleets' moved their laborious ways towards the coast of France, other mischief was afoot. Twenty-nine Stirling and Halifax bombers of Nos 90, 138, 149 and 161 Squadrons RAF staged fake airborne invasions — code-named TITANIC — in the Caen and Cap d'Antifer areas. On their way to the 'dropping zones' the bombers released large quantities of Window, to increase the apparent size of the force on enemy long-range radars.[25] At the spoof landing areas they unloaded dummy paratroops fitted with special fireworks, which exploded to give off the crackles and bangs of a ground battle in progress.

To isolate the real dropping zones from marauding German night fighters, 29 Lancaster and Flying Fortress bombers of Nos 101 and 214 Squadrons

Meanwhile, the armada of more than a thousand transport aircraft laden with paratroops and equipment and many towing gliders, delivered their loads and returned to England without losing a single transport aircraft to night fighter attack

RAF produced a screen of communications jamming over eastern France between Dieppe and the Somme River. The aircraft patrolled the area for four and a half hours, flying at altitudes between 24,000 and 27,000 feet to ensure that Luftwaffe night fighters operating to the west of the jamming screen received no instructions from ground controllers to the east of it.[26]

The Luftwaffe controllers fell into the trap and vectored their night fighters to intercept the ghost 'bomber stream' over eastern France. But once the fighters arrived in the area of the communications jamming they could receive no further instructions from the ground. One Lancaster involved in the operation was shot down, but the crew survived.[27] Meanwhile, the armada of

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more than a thousand transport aircraft laden with paratroops and equipment and many towing gliders, delivered their loads and returned to England without losing a single transport aircraft to night fighter attack.

The first indication to the German High Command that a major seaborne force was moving towards the coast of Normandy, came at about 02.00 hours on 6 June when observers on the eastern side of the Cherbourg Peninsula reported hearing with their naked ears the rumble from the engines of the Allied ships.[28]

There is clear evidence that the German radar operators observed and reported the approach of the GLIMMER 'fleet'. A full-scale invasion alert was issued for the Calais-Dunkirk area, and motor torpedo boats were sent into the area to engage the 'invaders'[29] Dr Cockburn had predicted that 'Once a broad arrow representing an enemy attack appears on the situation map at a military headquarters, it is a military fact and it takes a lot to remove it'. His forecast is borne out to a remarkable degree by one German record of the morning's events. A telephone message logged at 10.15 hours on the morning of D-day at the forward echelon of the Luftwaffe High Command (by which time the spoof operations had been over for about six hours, and Allied troops were ashore in strength) contained a clear reference to Operation GLIMMER:

'On the night of 6 June the enemy carried out landings in the Seine Bay. Reports up to 0800 hours provide the following picture: at about 0300 hours a large number

of enemy landing craft and escorts neared the coast of the Seine Bay between Caen and Carentan. From observations on the coast and air reconnaissance, it appears that some 200 ships were involved. Landings appear to have been successful near Carentan and near the mouth of the Vire. The number of landing craft involved has not been reported. Near Bernieres 33 landing craft have been reported, and 44 more near the mouth of the Orne (north of Caen). It is estimated that eighty large landing craft would be able to put ashore 3 to 4 divisions.

'During the early morning darkness (first light was at 0500 hours) artillery fire fell at the following places: Grandcamp, Colleville, Arromanches. There are no reports on the positions of the ships doing the firing. Between 0600 hours and 0700 hours coastal observers reported six large warships, including battleships, and approximately 20 destroyers at a position 10 sea miles west of Le Havre. Further reports on assemblies of ships: at 0645 hours to the north of Lesardrieux [west of St Malo], where it has been specifically reported that no landings have taken place up to now. According to reports from reconnaissance aircraft, ships were assembling during the morning off Dieppe and Le Treport. ***The reports of ships assembling off Calais and Dunkirk at 0400 hours have not, so far, been confirmed.*** [Author's bold italics].'[30]

Reconnaissance aircraft and fast patrol boats were sent to scour the seas off the coast off Boulogne to search for the suspected invasion force.[31] But trying to prove a negative was a difficult business, and it took a disconcertingly long time to prove conclusively that the enemy force was not where it was is thought to be.

Operation TAXABLE, though apparently correctly flown, appears not to have been noticed by the defenders.[32] Despite a search of surviving German records, this writer found no report that can be linked to the spoof.

Some of the countermeasures prepared for OVERLORD were not needed. The Luftwaffe made no attempt to disrupt the airborne landings by jamming signals from the Eureka beacons marking the dropping zones, so the 'Lucero' Mosquitoes saw no action.[33] As the ground battle developed, the Allied fighter force maintained a powerful umbrella of patrols over the beachhead which prevented the Luftwaffe from mounting co-ordinated attacks into the area. As a result the huge Elephant Cigar communications jammer near Brighton, standing ready to beam a cacophony of jamming on the German aircraft radio channels, remained silent.

The rest of the story is well known. Once the Allied troops established a beachhead in Normandy, no power at Adolf Hitler's command could dislodge them. By sowing confusion and preventing German commanders from gaining an accurate appreciation of Allied movements, there can be no doubt that the radio countermeasures operations materially assisted the landings and did much to hold down casualties. In terms of the losses they saved, the resources committed to countermeasures operations had been minimal. For the student of electronic warfare, the operations in support of OVERLORD provide an object lesson on what can be achieved if a carefully planned program of countermeasures is used to support a one-of-a-kind operation of the highest importance.

Notes

1. Sir Robert Cockburn, interview.

2. RAF Signals History Volume VII, Radio Countermeasures, p 228.

3. Ibid, p 229

4. Cockburn interview

5. Telecommunications Research Establishment account The Radio War p 72-73

6. Cockburn interview

7. RAF Signals History p 230

8. Ibid

9. George Haller, interview

10. Ibid

11. Ibid

12. IEE Proceedings, Volume 132, Part A, Number 6. The work of TRE in the invasion of Europe, Prof J. Pringle, p 347.

13. Cockburn, R. The use of Window to simulate low level targets on enemy radar, TRE Memorandum 5/M.95, RC, 28 April 1944.

14. RAF Signals History p 233-234.

15. The Radio War p 77

16. Cockburn interview.

17. The Radio War op cit

18. Cockburn interview

19. Leigh-Mallory Dispatch, quoted In Wilmot, Chester, The Struggle for Europe, Fontana Edition, p 279.

20. The Radio War p 79

21. RAF Signals History p 236

22. Cockburn interview

23. Cockburn, R: The Moonshine operation on 6th-7th June 1944. TRE Memorandum 5/M.95/RC, 13th June 1944

24. The Radio War, p 77.

25. RAF Signals History p 235.

26. Ibid, p 237

27. Ibid p 239

28. Wilmot, op cit, p 279

29. RAF Signals History p 239

30 Luftwaffe telephone log An Kurfuerst v. Robinson, 6.6.44. Freiburg Document Collection.

31. RAF Signals History p 239

32. Ibid

33. IEE Proceedings, op cit, p 347