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Chapter 5

Air defence of the Bristol Channel

By the time of the negotiations for the Munich Agreement in September 1938, the German Ministry of Propaganda had managed to sell to the world the idea that the German airforce was capable of subduing any other country by mass bombing. Vastly over-inflated figures of the size and power of the *Luftwaffe* were supplied to the press of one country and, as intended, these were picked up by other media organisations and reported as sensational news. The occupations of Austria and the Sudetenland had provided demonstrations of the actual effectiveness of the *Luftwaffe* and it began to be feared throughout Europe. When in March 1939 German troops invaded Czechoslovakia, they were accompanied by 500 aircraft from which airborne troops were landed in and around Prague. As the possibility of war with Britain became a probability, exercises were carried out to simulate attacks on British harbours and forward aerodromes were built in western Germany (PRO 2001, 18–19). Over the following year Britain invested considerable sums on both air defence and Civil Defence (Air Raid Precautions – ARP) but when war was declared the expected massive air strike against London did not materialise.

At the outbreak of war, Somerset was considered to be in the safe area outside the 400-mile (640km) radius of bombers operating from airfields in Germany. Because of this minimal risk of German air attack, part of the British Expeditionary Force was deployed from the Bristol Channel to Brest and Nantes. Children were evacuated to Somerset from London. The invasions of Poland, Norway, Denmark, Holland, Belgium and France demonstrated convincingly the threat of German air power as a bomber force against land and naval targets, in close support of ground forces and its ability to land airborne troops. After the fall of France in June 1940, the move of two *Luftwaffe* Air Fleets into the north of occupied France (Figure 2.6 on page 10) brought Somerset and the Bristol Channel to within 200 miles (320km) of the new aerodromes in the Brest and Cherbourg peninsulas. This allowed enemy fighters to escort their bombers over most of the Bristol Channel (Collier 1957, 160).

In the period from 7 September 1940 to 16 May 1941, Bristol suffered seven significant bombing raids, Avonmouth five, Cardiff three and Swansea three (Collier 1957, 503–4). Mines laid by aircraft had a major effect on shipping, for example closing Barry Dock between 7 and 10 October 1941 (Jory 1995, 48). The German bases in France also allowed increased air reconnaissance for attacks against ports and shipping. In March 1941, the *Luftwaffe* moved a special unit (III KG 27) into the Brest peninsula with aircraft equipped for guiding submarines onto shipping in the Bristol and St George's Channels (Hinsley 1979, 330). Devon and Somerset were now on main routes for bombers flying to attack cities and industrial targets in the Midlands and the western ports in addition to the Bristol Channel.

The 1940 UK air defence network consisted of the Chain Home (CH) radars along the coast looking out to sea primarily over the

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Figure 5.1: *A 4.5-inch AA gun on the ranges at Doniford. These guns were also used in a dual anti-aircraft and anti-shipping role on Flat Holm (courtesy Vernon Stone from a postcard by HH Hole).*

North Sea and the eastern end of the English Channel but with very limited coverage inland. There were wide gaps in the radar coverage along the coasts of the south-west peninsula, particularly to the south of Somerset in east Devon and west Dorset, and no coverage along the Bristol Channel coast (Collier 1957, 149). While the CH radars provided tracks that enabled controllers to direct fighters towards the enemy over the English Channel, once the enemy crossed the south coast, the only source of tracking and identification information came from Observer Corps posts and additionally from searchlights by night.

Daytime interception worked reasonably well but by night it proved extremely difficult for searchlights to locate the enemy and the night fighters then to find the illuminated aircraft. The later use of aircraft interception (AI) radars fitted in fighters is discussed below (on page 63). The air defence warning installations in Somerset and along the Somerset coast were vital in tracking the raiders before they reached their targets in the shipping lanes of the Bristol Channel and the ports and industrial installations along the south Wales coastline, where it was obviously not possible to deploy forward defence installations.

Anti-aircraft guns

The importance of the Bristol Channel ports may be gauged from the allocation of anti-aircraft guns to defend them. In June 1940, before the threat from France had been fully assessed, only Bristol, Newport and Cardiff were gun-defended areas (GDA) with a total of 36 heavy AA guns (HAA). This was about 3% of the national total at the time. By August 1940, the defences had been strengthened to 90 guns, including a new gun-defended area at Swansea, which then represented about 7% of the national total (Collier 1957, 449). On 6 March 1941, Churchill directed: 'We must be prepared to meet concentrated air attacks on the ports on which we specially rely (Mersey,

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Clyde and Bristol Channel). They must therefore be provided with a maximum defence.' (Churchill 1949, 109). The number of guns was further increased in 1941 to 190 which was about 11% of the national total. By 1944, with the preparations operation Overlord, the totals had further increased to 247 guns. Later in February 1941 HAA guns were deployed near the Somerset coast to protect Weston-super-Mare aerodrome and the nearby aircraft factory (Dobinson 2001, 519).

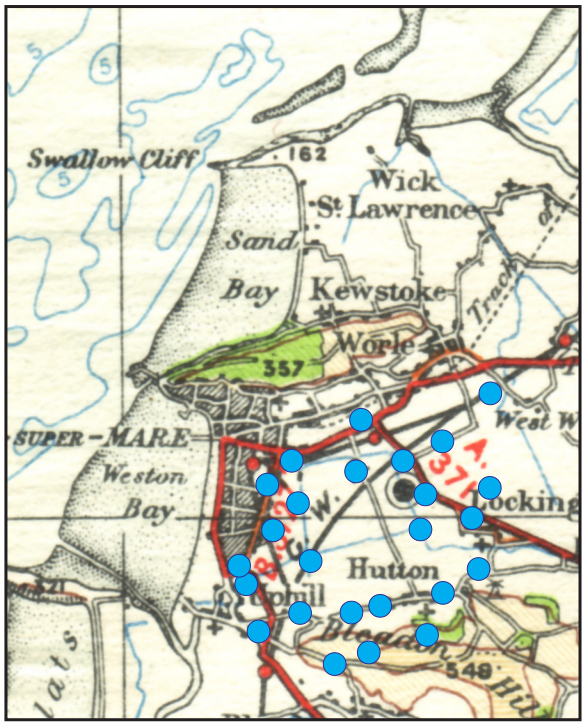

Figure 5.2: *Barrage balloon sites (superimposed blue dots) around the aerodrome (black circled dot) at Weston-super-Mare and the Bristol Aircraft shadow factory at Hutton. The 24 balloons were deployed in an inner and outer ring around the targets. Base map: Ordnance Survey 1:253,440 sheet 11. Fourth Edition, 1945, full revision 1930.*

RAF balloon barrages were also deployed to the main ports. On 27 August 1939 the first barrage of 32 balloons was deployed to protect Avonmouth and Portishead docks and remained in place until 12 July 1944 when the balloons were redeployed to the south-east of England against the threat of flying bombs. At Bristol, balloons were first deployed on 7 September 1939 while on 2 April 1940, 40 balloons were deployed to protect the city docks. Deployment of barrages, of 24 balloons each, to the Bristol Aeroplane Company factories at Filton and Weston-super-Mare were made on 1 June 1940 and 3 May 1941 respectively (John Penny pers. comm.). By 31 July 1940, Bristol had 72 balloons and Cardiff 39 of which seven were waterborne. By the end of August 1940, additional balloons had been deployed (Collier 1957, 480): to Swansea (35 balloons), Port Talbot, (16), Newport (40) and Barry (16).

RAF fighter organisation

In July 1940, RAF Fighter Command established a new fighter group at Box (Rudlow, Wiltshire) near Bath to cover the South West. The new group (10 Group) took control of the three sectors based at Pembrey in south Wales, Filton near Bristol and St Eval in Cornwall (Figure 5.3 on the following page). In August the Middle Wallop sector was also transferred to 10 Group. The four Sector Operations Rooms each received information about the position of enemy aircraft from 10 Group that was based on Chain Home radar plots and reports from the Observer Corps. On orders from 10 Group HQ they were then responsible for 'scrambling' their fighters into the air and directing them by RT (radio telephone) towards the enemy. Sectors had geographically separated direction finding (DF) 'fixer' stations. Two or three of these took simultaneous bearings on the VHF wireless transmissions of their fighters and thereby 'fixed' their positions.

A new fighter sector station was established at Exeter Airport in June 1940 which took over the role from St Eval. The new Exeter sector covered the English Channel coast and northwards towards the Bristol Channel. Raiders making for the latter waterway should have first been intercepted over the English Channel or the south Devon or Dorset coastline. In the autumn of 1940, the Filton sector control

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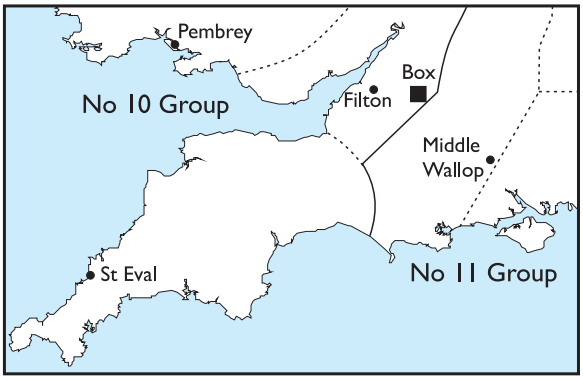

Figure 5.3: *RAF Fighter Command organisation on 9 July 1940 (after Collier 1957, map 12, 161).*

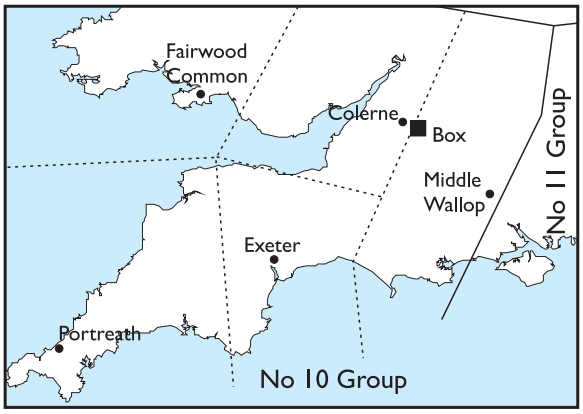

Figure 5.4: *RAF Fighter Command organisation in Spring 1941 (after Collier 1957, map 24, 267).*

was moved to Colerne in Wiltshire and the sector boundaries changed so that it covered the Bristol Channel north of the north Devon and west Somerset coastline and was renamed the Colerne sector (Figure 5.4). This provided the second line of defence to the north of the Exeter sector while the raiders were over Somerset (Collier 1957, 149). A satellite day fighter station to Exeter was opened at Churchstanton (later renamed Culmhead) on the Blackdown Hills in Somerset on 1 August 1941. Among other duties, fighter aircraft flying from the aerodrome were involved as convoy escorts in the English Channel (Berryman 2006, 55).

Observer Corps

The Observer Corps was the primary source of information about the position, type and strength of enemy aircraft that had crossed the coast. The Corps was run by the RAF using both paid civilians, who contracted to work 24 or 48 hours per week, and volunteers to run small observation posts approximately six to ten miles (10–16km) apart. These were connected by direct telephone lines to their associated group centres at Bristol (23 Group), Yeovil (22 Group) and Exeter (21 Group). Each group typically controlled 35 to 45 posts. Observer group centres with posts near the coast had direct lines to the appropriate Chain Home radar station allowing posts to be warned of incoming raiders. The posts along the Somerset coastline were all operational from 1938 (Wood 1976, 307–9). Each post needed about 20 people to run it continuously with two on duty. Observer group HQs typically needed 150 to 180 staff and from July 1941 women were enrolled.

In addition to their primary role of identifying and tracking aircraft, both hostile and friendly, the Observer Corps posts assumed a number of other important roles. These included reporting landings of parachutists or troop carrying aircraft, enemy submarines or surface craft, aircraft laying mines in coastal waters, aircraft in distress, lost aircraft and crashes. Posts near the coast were often linked to nearby Coastguard stations by landline and in Somerset, the Porlock (ExHER MSO12292) and Highbridge (SHER 12830) posts were both connected. If communications broke down, posts fired red rockets with red stars to indicate enemy action on land and green rockets with stars to warn of approaching enemy surface craft. Posts also assisted lost aircraft and in late 1942 some posts, including those at Porlock and Holford, were equipped with 'Darkie' wireless to communicate with lost aircraft at night. Searchlight sites could then be called to direct the aircraft to the nearest aerodrome using their light beam. Other posts were equipped with 'Granite' flares, which could be lit to warn friendly aircraft in conditions of poor visibility of the proximity of high ground. The posts at Porlock (ExHER MSO12292) and

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Dunster (SHER 35805) were both equipped with 'Granite' to warn approaching aircraft flying south from the Bristol Channel of the cliffs along the coast and the high ground of Exmoor beyond them. The Holford post also had 'Granite' to warn of the proximity of the Quantock Hills (Wood 1976, 308).

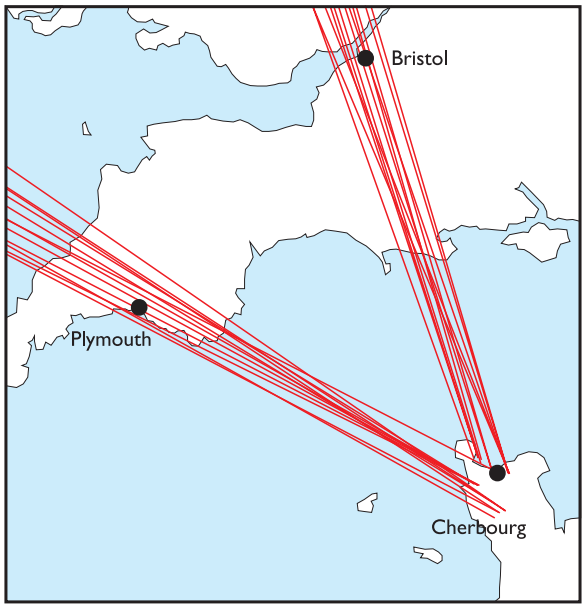

Figure 5.5: *The threat of V1 missiles to the South West. The lines of flight were projected from aerial photographs showing the orientation of the launch ramps on the Cherbourg peninsula. The missiles could be timed to fall onto targets along the line (after Babington Smith 1957).*

The information provided from the Observer Corps was also critical for the air-raid warning system. In particular, special 'purple warnings' enabled 'permitted lighting' to be used in certain principal ports, which enabled stevedores to work a three-shift system throughout the hours of darkness, as the lighting could be extinguished when there was warning of an imminent threat of air attack. The Somerset Observer Corps posts were a vital part of the warning system for the Bristol Channel ports and particularly those in south Wales (Wood 1976, 126).

In April 1944 RAF air photographs identified the threat of V1 flying bombs being launched from sites under construction in the Cherbourg peninsula (Figure 5.5), which were clearly aligned towards Bristol and Plymouth (Babington Smith 1957, 199). The Observer Corps Bristol and Yeovil groups were ordered to be ready to track V1 attacks. In the period up to D-Day, Bristol was to be defended by 96 heavy AA guns and 216 light AA guns and a key aspect of the plans was the assumption that the Observer Corps would be able to identify and track the missiles, giving ample warning for fighters to attack and thus avoid the need for standing air patrols (Collier 1957, 364). The attacks never materialised as the initial successes of the Allied invasion over-ran the launch sites.

The Corps was granted the title 'Royal Observer Corps' (ROC) by the King in April 1941, in recognition of their outstanding work; it was believed to be unprecedented for the title 'Royal' to be awarded in wartime.

Searchlights

By night, the observer posts were often unable to track raiders or fighters effectively and the main method of locating hostile aircraft was the network of Army searchlights. These were initially deployed at approximately 6000 yards (5.5km) spacing and sites were equipped with a primitive sound locator to guide the searchlight towards the hostile aircraft. The primary role of the lights was to locate and illuminate enemy aircraft so that the fighters could find and attack them. The lights also forced the enemy to take evasive action by weaving or flying higher, which might impair the ability to accurately bomb. Searchlight sites were all equipped with a Lewis anti-aircraft light machine gun, which turned out to be an effective weapon against aircraft flying down the searchlight beam to attack the light and was also important for defence against potential parachutists (Price 1977, 52, 54). Before gun-laying (GL) radars became available, searchlights were also essential for illuminating targets for the heavy AA guns defending the major

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ports and without them the guns were powerless to engage targets by night. An increased density of searchlights was therefore deployed around gun-defended areas for this purpose but it was found that this actually assisted the enemy to identify their target (Cooper 2004, 52). Searchlights were connected by telephone and wireless through their battery HQs to an Army cell in the RAF Sector Operations Room (Collier 1957, 483).

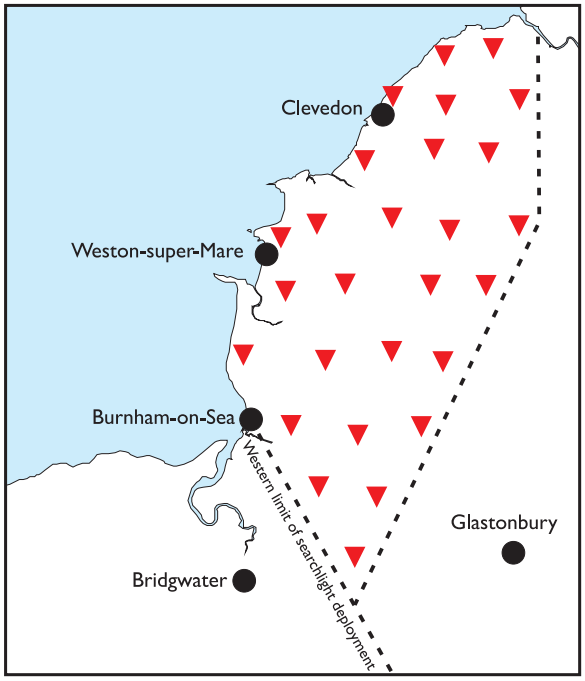

Figure 5.6: *Searchlights deployed in the Coastal Defence Zone in mid 1940. Inland searchlights in the Glastonbury area are not shown.*

The initial searchlight deployment in Somerset only covered the coastline north of Burnham-on-Sea and southwards to Yeovil and Portland (Figure 5.6) but, during the summer of 1940, the coverage was extended westwards. Cover had also been deployed along the Welsh coast as far west as Swansea (TNA WO 166/3292, map). In November 1940 with the arrival of more powerful searchlights and with increasing manpower shortages, it was decided to 'cluster' the lights in groups of three with clusters spaced uniformly at 10,400-yard (9.5km) separation across both gun-defended and fighter-defended zones to avoid giving the enemy any indication of gun sites or targets (Figure 5.7 on the facing page). Each cluster had one of the new 150cm searchlights which could illuminate targets up to 20,000 feet (18.3km) and two of the old 90cm lights. This was intended to improve the chance of picking up and 'coning' enemy aircraft in three beams. Practical experience showed that although a single searchlight might illuminate a raider, the night fighter might not be able to see the raider and an intersection of two beams was essential to ensure the fighter could identify the position and height of the enemy aircraft (TNA WO 166/2076, letter of 8 November 1940).

In the autumn of 1941, it was decided to once again redeploy the searchlights, this time into 'fighter boxes' each 14 miles deep and 44 miles (22 x 70km) wide with radar controlled searchlights deployed at 6000 yard (5.5km) intervals to form a 'killer zone' (Figure 5.8 on page 64). On the enemy approach side of the box, lights at 10,400 yard (9.5km) separation gave early warning of the approach of the enemy. A searchlight shining vertically near the centre of the box provided a marker beacon for the waiting night fighter to orbit around until directed by the orbit beam 'slapping' down towards the enemy which was by then illuminated by other lights in the box (Dobinson 2001, 344–45). Even so, it still proved difficult for night fighters to find the intruders. Searchlight control radars (SLC), which were also known as 'Elsie', were deployed as they became available. These had a range of about eight miles (13km) (Price 1977, 112). Gun-laying (GL) radars were also deployed to some searchlight sites to assist in locating enemy aircraft and to give warning of raiders up to 30 miles (48km) away.

Figure 5.9 on page 65 shows a typical 1942 searchlight battery deployed with 24 searchlight sites and 15 radars in the approximate area between Lynton, Porlock, Tiverton and South Molton, as part of the Exeter Sector 'Fighter Box' deployment, with the battery HQ at Exford. The four searchlights to the north are part of the indicator belt to give warning of

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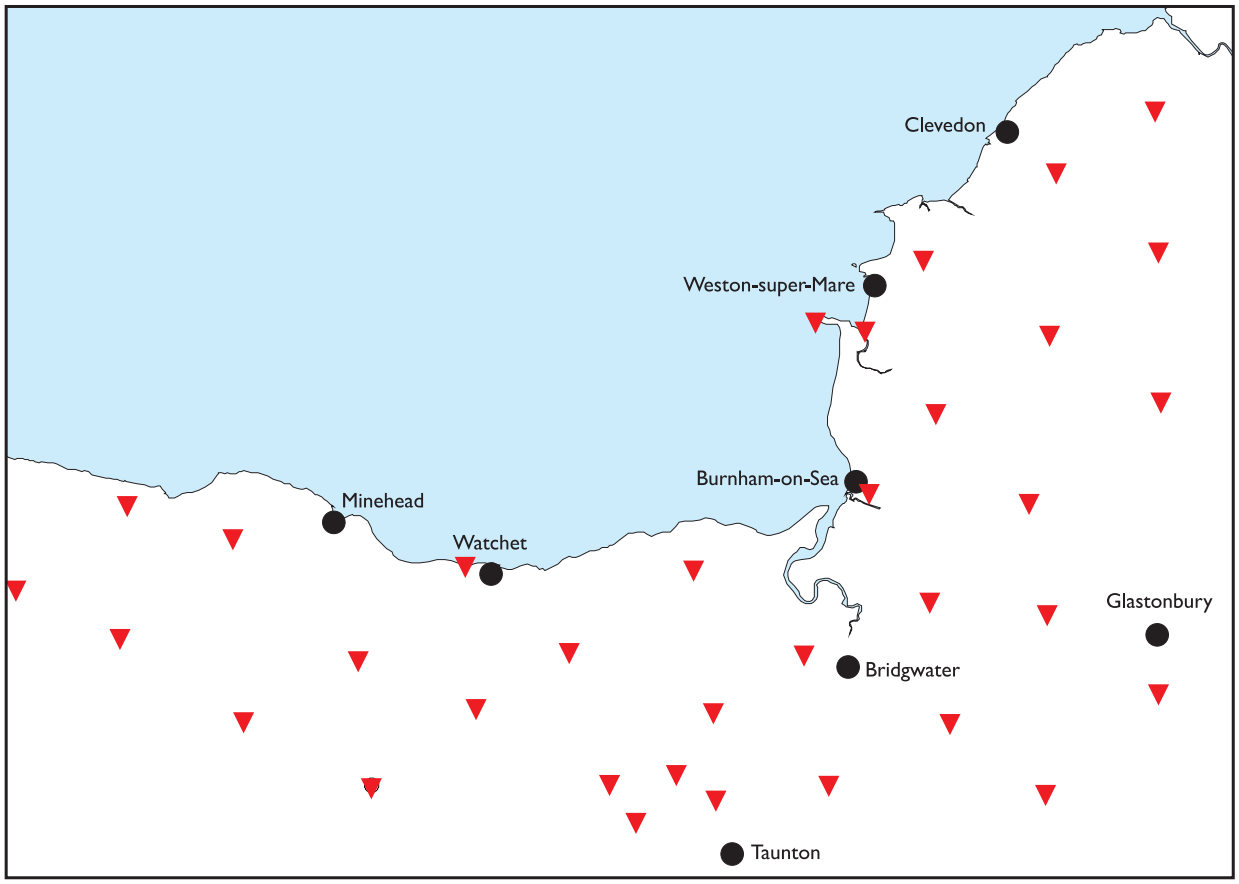

Figure 5.7: *Searchlight clusters in 1941 within the boundaries of Somerset. Each cluster consisted of three searchlights.*

enemy aircraft returning to their bases in north-west France. There was also the main indicator belt to the south, which is not shown on this map.

Air defence radar

Until September 1943, the British used the term RDF which was a compression of the initials RD for Radio Detection and DF for Direction Finding. A further term, radiolocation, was released for general use when the existence of RDF was disclosed to the public on 18 June 1941 in a House of Commons statement. The American term radar (radio detection and ranging) was later adopted to avoid differences in terminology between the Allies (Air Historical Branch 1950a, iii, note 1, 8).

The use of radar is a complicated subject, both because of the secrecy that surrounded its invention shortly before the war and because of the many types developed for use by the Royal Navy, the Army and the RAF in both air defence and coast defence roles. Army and some RAF radars were mobile and were moved to meet changing *Luftwaffe* tactics or to improve coverage.

The South West, including Somerset, was not part of the original Chain Home system, whose primary role was distant warning of hostile aircraft, concentrated on the south and east coasts looking seawards only. These radars had an average effective range of about 80 miles (130km) depending on the height of the aircraft. On 19 January 1939 it was decided that Chain Home should be extended westwards with a station at Prawl Point in south Devon to give warnings of attacks from the south of the Bristol and south Wales industrial areas and that a second station should be built

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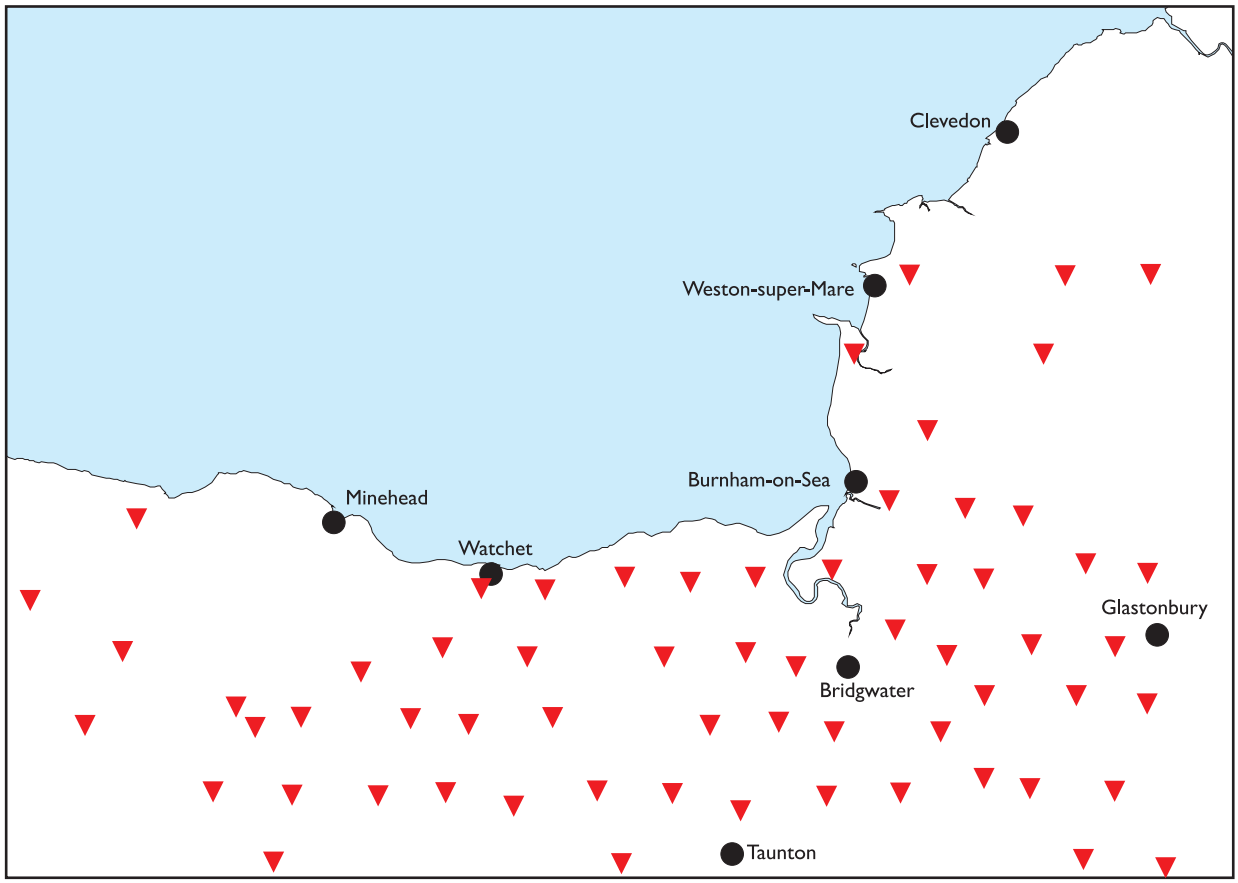

Figure 5.8: *Searchlights within Somerset in Fighter Box deployment in 1942.*

on Exmoor to cover the Bristol Channel. The proposed Exmoor station site at Exe Plain near Simonsbath did not provide the cover expected and was abandoned (Air Historical Branch 1950a, 60). Other sites investigated included Porlock Common, Brendon Common and Luckott Moor (TNA AIR 2/2685, BRS/4/8/1 of 2 March 1939).

After the declaration of war in September 1939 enemy aircraft started penetrating further than anticipated over the western areas of England and the Irish Sea so on 2 January 1940 the Prime Minister allocated the highest priority to closing the gaps in the radar coverage between Weymouth and Torquay at both high and low level with second priority out of a total of nine being provision for both high and low level over the Bristol Channel (Air Historical Branch 1950a, 85). In February 1940 various sites covering the Bristol Channel were examined including a possible Chain Home Low station at Countisbury Hill near Lynton in Devon. This was never built as a more suitable site had been identified near Porthcawl on the south Wales coast (TNA AVIA 7/256).

The German occupation of Denmark and Norway in April 1940 radically changed the requirement for radar cover, with an urgent need to cover the north-eastern coast of Britain (Air Historical Branch 1950a, 109). Radar was also being deployed to Middle East Command to cover areas such as Malta and the Suez Canal (Air Historical Branch 1950a, 103), which created additional demands for equipment and resources, particularly after Italy entered the war on 10 June 1940. This delayed the implementation of the plans for the South West. On 25 May 1940 as the Germans advanced towards Dunkirk, a new priority list for radars included at third place the provision of cover from the Lizard to the Bristol Channel, after the defence of London and the Channel approaches in

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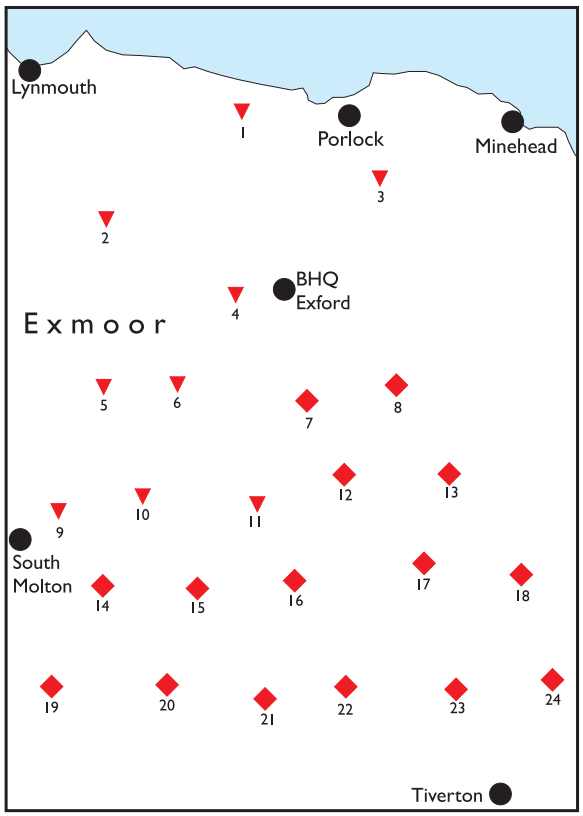

Figure 5.9: *Typical searchlight battery deployment in the 'fighter box' configuration in April 1942. 540 Battery of 88 Searchlight Regiment RA with 24 searchlight sites of which 15 had searchlight control (SLC) radar (shown by diamonds). This was the EX H area of the Exeter sector. Sites 1–4 formed part of the 'indicator belt' and the 'orbit point searchlight' was site 24 (locations from TNA WO 166/788).*

first place and Dover Strait to the Humber in second (Air Historical Branch 1950a, 109).

As already mentioned, the absence of radar cover inland meant that reliance was placed on the Observer Corps during the day and that tracking aircraft at night often depended on searchlight sightings, which at that time were still dependent on inefficient sound locators, and sometimes only on 'sound plots' by observers. However, radars were also being developed to control anti-aircraft guns (gun-laying or GL radars) enabling them to engage targets in poor visibility or at night. By June 1940 the first GL Mark 1 radars were deployed to most HAA sites but these only gave the range of the target up to about seven miles (11km) and not accurate elevation. This performance was improved by October 1940.

As a temporary measure in November 1940, a network or 'carpet' of gun-laying (GL) radars was established across southern England to track raiders inland (Figure 5.10 on the next page). Three GL radar-equipped AA gun sites around Bristol and Avonmouth, together with isolated GL radars deployed to new sites near Banwell and Wells, were connected by land-line to the Colerne Fighter Sector HQ. This gave some capability for tracking enemy aircraft over the eastern end of the Bristol Channel and its approaches from the south-east. Other radars in the 'carpet' were at South Brewham (later redeployed to Kilmington in Wiltshire) and Rode (TNA WO 166/2076, letter of 8/11/1940). This was at a time when the *Luftwaffe* had turned from the London Blitz to attacking ports; the first attack on Bristol with 134 aircraft was on 27 November 1940 (Collier 1957, 503).

By 1942 the list of GL equipped gun sites included 22 sites around Bristol, four at Weston-super-Mare and two at Yeovil. After the so-called Baedeker raids on Exeter and Bath in April and May 1942, three additional GL radars were deployed: one to Henlade (SHER 22513), one of the two new temporary gun sites at Taunton, and two to the Bath sites (TNA WO 33/1708). On 26 June 1942 this Taunton site with its GL radar engaged (unsuccessfully) aircraft on their way to attack Weston-super-Mare in another Baedeker Raid.

The problem of directing night fighters onto their targets was considerable. By day a fighter within three miles (5km) of an enemy could normally find its target but on a moonless night the fighter might not see the enemy until they were 300 yards (275m) apart. The night fighters were equipped with aircraft interception (AI) radars, which had a range of about three miles (5km) and therefore needed accurate guidance to get into AI radar-range of the target, which neither the Observer Corps nor searchlights could achieve (Crowther and Whiddington 1947, 28).

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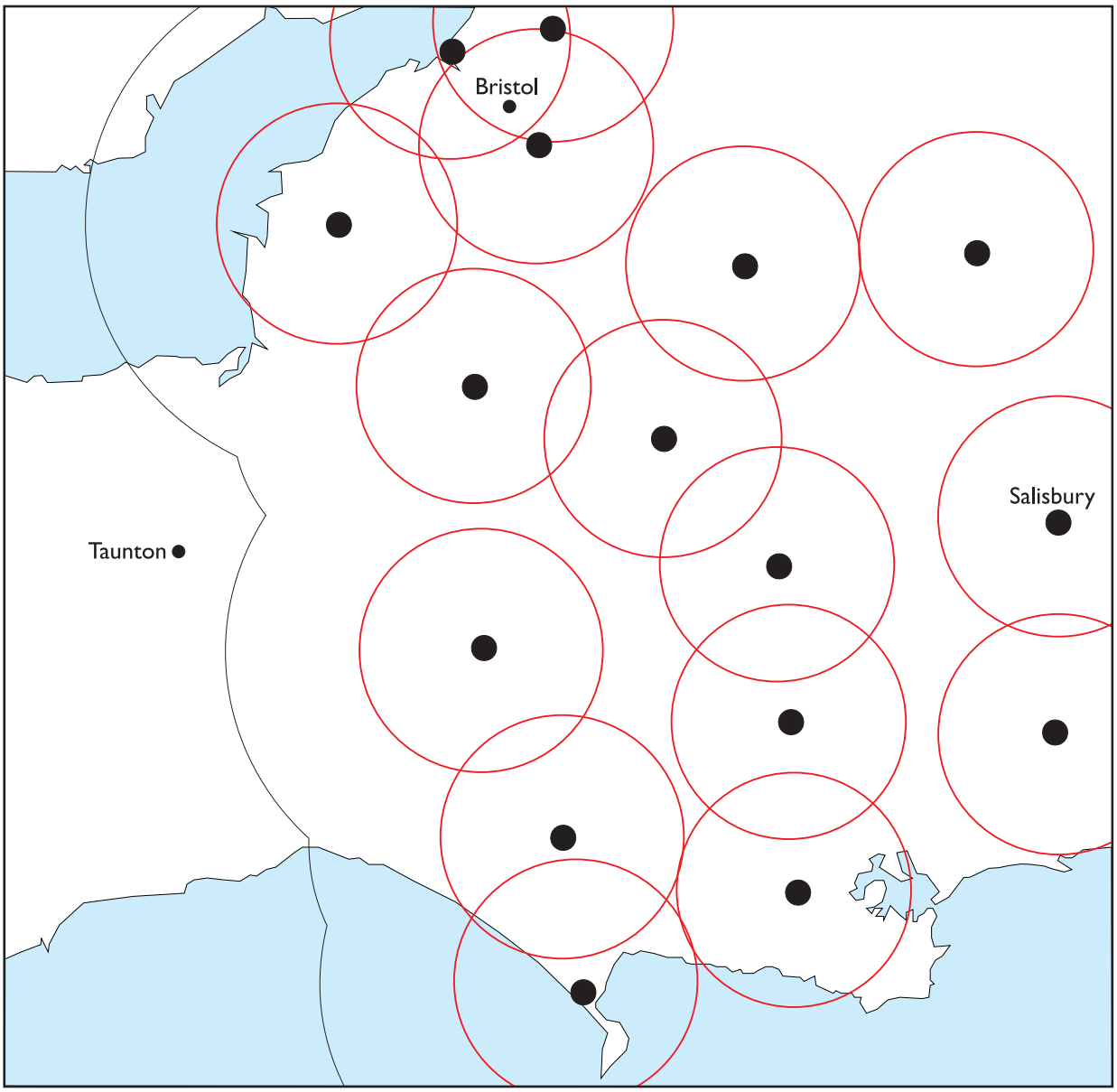

Figure 5.10: *Deployment of Army gun-laying (GL) radars as a 'carpet' to provide inland cover. The western edge of the maximum range (18 miles, 29km) at which the radar could first see an aircraft is shown; within the red circle (8-mile, 13km, range) the radar could accurately track the aircraft and report its position to the RAF sector.*

In 1941 a new Ground Controlled Interception (GCI) system using radars to direct night fighters onto enemy aircraft was deployed. The GCI radar stations were warned of approaching enemy aircraft from Chain Home radar plots passed through the filter rooms via group and sector HQs. The GCI radars could then pick up raiders at about 90-miles (145km) using their height finding radar and could start controlling fighters at a maximum range of approximately 60 miles (95km) on their main radar where both the raider and fighter were visible on a single screen with an outline map (the plan position indicator or PPI). The use of identification friend or foe (IFF) a device based on a transponder in the aircraft which re-transmitted the radar signal illuminating it to produce a distinctive spot on the radar screen, enabled the GCI controller to distinguish the RAF night fighters on the PPI. IFF was also essen-

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tial to enable GL and SLC radars to identify friendly aircraft and had a special facility to allow aircraft in distress to alert the radar operator so that its position could be passed to air-sea rescue units.

The GCI radar site had direct VHF radio telephone (RT) links to the night fighter and was able to navigate it into a position where it was able to identify the raider on its aircraft interception (AI) radar and close to attack the raider from behind. It was also important to prevent the fighter being silhouetted against the moon, sea or sky.

The initial deployment of the first six GCI radars in Britain included stations at Avebury in Wiltshire and Sopley in Hampshire but these only covered Somerset and the Bristol Channel east of a line from Burnham-on-Sea to Yeovil (Air Historical Branch 1952, 190–1). By March 1941 a site at Wrafton in north Devon to cover the western end of the Bristol Channel was planned to open in May but in April the top priority on a new list of 14 radars which 'were to be erected on coastal sites where their ability to see low-flying aircraft could be utilised against mine-laying and cloud flying raiders in daylight' was at Weston-super-Mare with Wrafton moved to priority six. At about this time the mobile GCI from Avebury was moved to Exeter where 'it would cover the route taken by aircraft crossing the coast at Lyme Bay and flying north over Somerset to the Irish Sea' (Air Historical Branch 1952, 202). In June 1941 a mobile GCI station was set up on Mark Moor, East Huntspill (Dobinson 1999, appendix 3), about ten miles (16km) south of Weston-super-Mare and presumably this site was selected on open flat ground as the hills near Weston-super-Mare would have screened the radar. The site for RAF Huntspill (SHER 44777) was reconnoitred by a Miss Francis in May 1941 who suggested using the road as all the fields were wet. In the event a field to the south of the road was used with the mobile cabins set out in a north–south line. The site was to be set up on 4 June and be operational a week later (TNA AVIA 7/1427). There were plans in November to provide accommodation in huts and a fully permanent station was envisaged. By this time GCI stations (Figure 5.11) were sited at Exminster and Hope Cove in south Devon, Wrafton in north Devon, Sturminster Marshall in east Dorset and Sopley in south-west Hampshire and which provided overlapping cover over the approaches to the Bristol Channel.

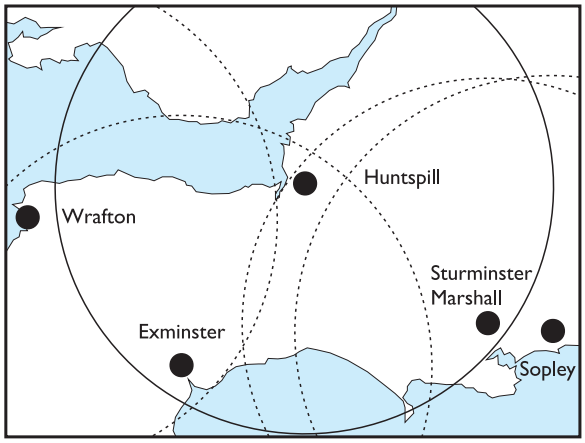

Figure 5.11: *GCI radar coverage from Huntspill (solid circle) and adjacent radar stations in November 1941.*

Eventually in January 1942 it was decided to move Huntspill GCI to a new location at Long Load approximately 14 miles (22km) to the south and permanent buildings were being built there in November (SHER 56972). However, the programme was curtailed in December (Dobinson 2010, 485–487) and construction appears to have been abandoned with the operations block partly built.

On a list dated 28 January 1943 Long Load was entered as 'operational' with an 'Intermediate Mobile' equipment which was expected to remain there as a long term solution (Air Historical Branch 1952, 284). It is likely that a fixed aerial was in position, as that was to have been the first construction, but the rest of the site was developed in temporary huts. By 1943, the GCI stations were becoming increasingly successful and each site was provided with direct communications to the local ROC centre; Long Load was connected to the ROC Group HQ at Yeovil. Aerial photographs taken

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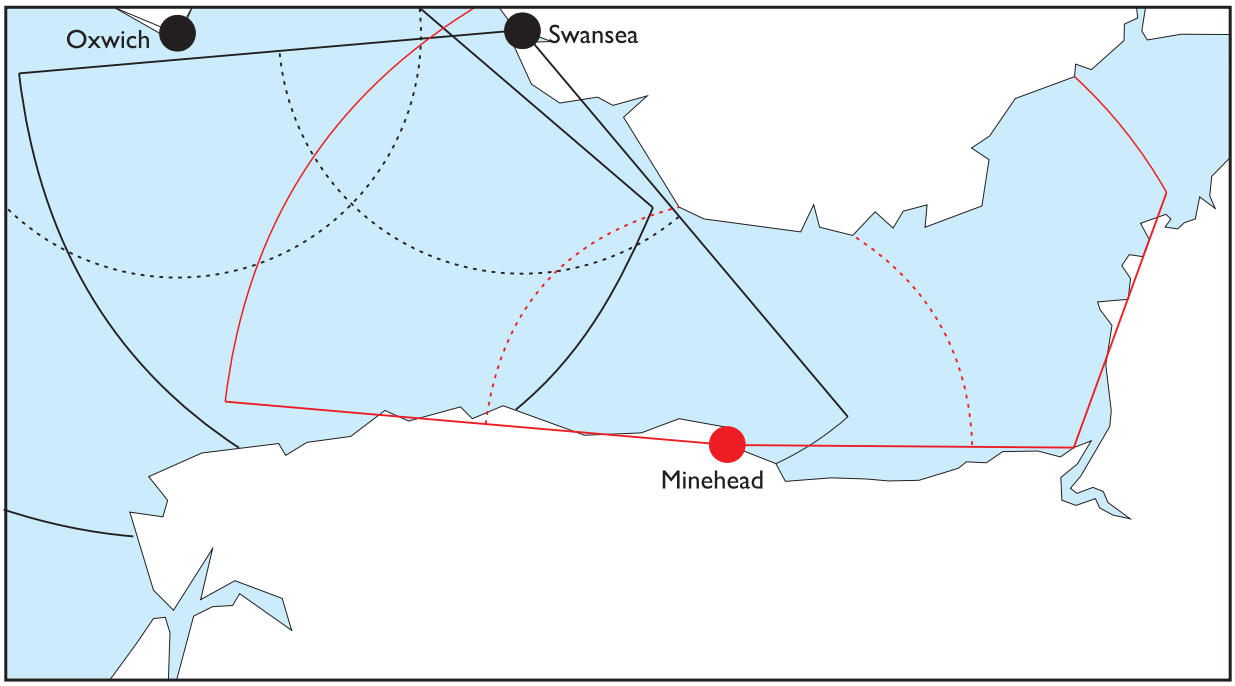

Figure 5.12: *The surface coverage against shipping of the Minehead CD/CHL radar together with adjacent radar stations in 1942. When visibility exceeded 20,000 yards (18.3km), Army radars might be permitted to be switched off and the inner (dashed) lines indicates this range. The Plan Position Indicator of Army radars covered a maximum range of 25 miles (40km) which is shown by the continuous line (after TNA WO 6114 and Air Historical Branch 1950a, 139).*

in January 1947 show the roofless operations block, the shadow of the aerial, completed standby-set house and wooden huts.

Finally it should be noted that just as the RAF Y-Service intercepted German ground to air wireless traffic (see on page 70 below), the *Luftwaffe* did exactly the same and GCI radio traffic between the radar site and the fighters was sometimes intercepted, allowing coded instructions to be sent to the intruder telling him to take violent evasive action to shake of the RAF night fighter tailing him (Air Historical Branch 1952, 211).

CHL/CD radars

Another development was the Chain Home Low (CHL) radar which could be used to locate both low-flying aircraft and ships. In the air defence role, the CHL radars were each normally associated with Chain Home sites to fill in gaps in the low level coverage of the CH stations. The CHL radars had an average range of about 30 miles (48km) depending on the radar site and the height of the aircraft. An example is the CHL station which was established in July 1941 on the cliffs at Beer Head in Devon near to the CH station which had been opened at Branscombe in October 1940. The new CHL improved low level coverage over Lyme Bay, enabling detection of low-flying enemy aircraft making northward toward the Bristol Channel and beyond (Passmore and Passmore 2008, 17).

In May 1942 a Coast Defence/Chain Home Low (CD/CHL), radar was established on North Hill, Minehead (Figure 5.12) which was taken over by 558 Regiment Coast Artillery (TNA WO 166/7178). The site was on high ground (732 feet, 225m, above sea level) and had excellent coverage northwards over the Bristol Channel. Army-controlled surface-watching radar stations were employed primarily in the detection of surface vessels

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and their movements. In addition stations could be ordered to supply information on aircraft observed and, if specially ordered, might be placed under direct control of the Navy. The stations reported through Army Plotting Rooms, which collated the information and passed it to the Army, Navy and RAF (TNA WO 166/6114).

An Admiralty chart dated 11 December 1942 ('British Isles: R.D/F Home Chain–Surface Watching) shows the air coverage of Bristol Channel radar stations. Minehead CD/CHL station is marked with the letter 'S' indicating that its primary role was anti-shipping as the air approaches to the Bristol Channel were then adequately covered by other radars. All the CD/CHL radar sites were later transferred to the RAF and at the same time 'operational control' of the sites passed to the Admiralty. In January 1944 Minehead was returned to GHQ Home Forces and thereafter its use is not clear (Dobinson 1999, 144).

In May 1944 a mobile high power Chain Home Extra Low radar was moved from Bolt Tail on the south Devon coast to Flat Point to the west of Ilfracombe in the surface watching role to guard the Bristol Channel but this was removed at the end of July 1944 (Air Historical Branch 1950a, 638).

Radio Counter Measures

The RAF was aware of the possibility of the use of radio beams by the *Luftwaffe* to guide bombers accurately to their targets. Beams were first identified on the night of 22–23 June 1940 by a specially equipped aircraft from Boscombe Down. The accuracy of the beams was such that a special RAF unit, 80 (Signals) Wing, controlled directly by the Air Ministry, was set up in August 1940 to develop and deploy measures to minimise the effectiveness of the beams. A 'Wireless Intelligence and Development Unit' provided airborne support. The activity was called Radio Counter Measures or RCM (Brettingham 1997, 10).

Both the *Luftwaffe* beam guidance systems and the RAF radio counter measures against them were novelties in aerial warfare and throughout the war there was an on-going battle of technology and tactics between the two air forces. Radio counter measures is a highly technical subject and the following discussion is therefore very broad-brush and greatly simplified. Only those aspects which affected the Bristol Channel or whose sites were located in and around Somerset are considered. No attempt is made to recount the history of radio counter measures or describe all the technical, organisational or operational changes that occurred.

Figure 5.13 on the next page gives a summary of the main German navigation systems, their British code names and code names of the counter measures used against them and the main sites in Somerset where these counter measures were deployed.

Knickebein

The original *Luftwaffe* system codenamed *Knickebein* ('crooked leg') consisted of two narrow beams which intersected over the target; the main beam was transmitted from France and the other from the Low Countries. The bombers from France flew along the main beam until they crossed the point of intersection of the second beam, which indicated their arrival in the target area. The system was accurate to within roughly a square mile (1.5km), which made it highly suitable for the mass bombing of urban areas by night or in poor weather (Richards 1953, 193; Jones 1978, 97–99. An important feature of *Knickebein* was that it used the Lorenz blind landing system with which all German bombers were equipped and with which all their crews had experience (Air Historical Branch 1950b, 5).

The RAF counter measure first used was simple jammers to swamp the beam signals. The system was code named 'Aspirin'. One of the first Aspirin sites was established on 10 August 1940 in Glastonbury Police Station

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German Navigation System	British Code Name	British Counter Measure	RCM Stations in or near Somerset
Knickebein	Headache	Aspirin	Fairmile (Devon) Shipham Porlock Glastonbury Templecombe
X-Gerät	Ruffian	Bromide	Shipham Porlock
Y-Gerät	Benito	Benjamin/ Domino	Shipham Porlock Templecombe Gittisham Hill (Devon)
Medium Frequency Beacons	–	Meacon	Highbridge (Rx) – Lympsham (Tx) Honiton (Rx) – Fairmile (Tx) Kington Magna (Rx) – Templecombe (Tx)

Figure 5.13: *Luftwaffe Bomber Navigation Systems (Tx = transmitter, Rx = receiver)*

using an old hospital diathermy machine, which the police switched on when orders from 80 Wing were received by telephone. Other jammers were sited at the police stations in Newton Abbot in Devon and Wimborne Minster in Dorset. As improved jamming equipment became available Radio Counter Measures sites were established at five sites across southern England including Templecombe in Somerset, which became operational during July 1941. Other sites were established at Shipham and Porlock in Somerset, Fairmile, Ivybridge and Newton Abbot (Devon) and Delabole (Cornwall) allowing the diathermy equipment to be withdrawn from police stations. Glastonbury was closed on 20 January 1941. The Shipham and Porlock sites were located on high ground, which gave good cover over the Bristol Channel (TNA AIR 41/46).

This jamming had some successes but it was always necessary to first detect the narrow beams set on a target, which were only switched on before an attack and then to measure the frequency being transmitted. It was discovered that ground 'watcher' stations could receive the beams but airborne investigation capability was still important to measure their alignment. Watcher stations in the South West in 1940 were sites at West Prawl (Devon), Coverack (Cornwall) and Portland (Dorset). Depending on which beams were radiating and their directions, the best placed Aspirin stations were then ordered to transmit on the appropriate frequency when the enemy came in range. Knowing where the enemy aircraft were depended on Observer Corps, searchlights and, later, the inland radars.

The RAF Y-Service produced invaluable minute-by-minute information on the activities of raiders by monitoring their aircraft radio communications and locating their positions by directional finding fixes (see below).

In the autumn of 1940, bomber losses in daylight raids during the summer led the *Luftwaffe* to resort to night raids as the RAF fighters were significantly less effective at night. The Germans increasingly realised the effectiveness of RAF counter measures against *Knickebein* and came to rely on periods of bright moonlight for large scale attacks as individual aircraft could navigate to the target area and see their target.

The RAF 'Y-Service' operated a number of intercept stations listening to both transmissions from aircraft and locating beams after they were switched onto a particular target. The main 'Y-Service' sites in southern England

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were at Kingsdown in Kent, Shaftesbury in Dorset and Strete in south Devon. These were called Home Defence Units (HDU) to conceal their real mission. HDU dealt primarily with *Luftwaffe* aircraft VHF voice communications, primarily in fighters, while aircraft HF communications, primarily in bombers, using wireless telegraphy (WT, ie Morse code) were monitored by RAF Cheadle. Reports from pathfinder aircraft when targets had been marked and requests from German DF fixer stations for their position before the return flight (if the MF beacons were being 'meaconed', see page 72) provided invaluable immediate intelligence for the air defences, Radio Counter Measures and decoys, as will be explained later. In addition throughout the war 'wireless investigation aircraft' identified enemy navigation aids and tested the counter measures deployed against them.

These sources, together with information (code-named Ultra) from code-breakers at Bletchley Park, often gave the British valuable information about enemy plans for raids and, in particular, their targets for the night, allowing RCM to be instigated. This is a huge subject and, as there were no known Y-Service stations in Somerset, a single example of how the information from Bletchley Park often allowed air defences and Civil Defence services to prepare for air raids will be noted.

The war-diary of Gloucester Sub Area based in Bristol relates that on 21 January 1941, warning was received at 1530 hours from the Regional Commissioner that aerial attacks were expected in the Temple Meads area of Bristol at 1830 hours. The bombers arrived at 1850 hours and the attacks lasted most of the night (TNA WO 166/1266). The source of information was a closely guarded secret and it may be assumed that those on the Ultra list with a 'need to know' had significantly better information than that on more general release. Nevertheless such intelligence was not always available. It was not possible to intercept all wireless traffic and to then break the cipher in time for it to be of immediate value.

By the end of 1941, the British had identified 11 *Knickebein* stations between Stavanger in Norway and Morlaix on the Brest peninsula in north-west France and also a station at Lörrach in southern Germany. About a quarter of these stations were to the south of the Bristol Channel and on the routes for the south Wales ports or the industrial Midlands (Hinsley 1979, 555 and appendix 11). Throughout the war the *Luftwaffe* continued to use *Knickebein* and refine it against RAF counter measures.

X-Gerät

In August 1940, the Germans started to deploy an improved and more accurate system (the *X-Gerät*) with multiple cross beams to enable the aircraft position and ground speed to be computed and the exact bomb release point to be indicated. The system was only fitted in the specialised pathfinder aircraft of KG 100 (*Kampfgeschwader* – roughly the equivalent of an RAF bomber group), which dropped incendiary bombs on the target to cause fires enabling the main bomber force to find the target. Stations in the Brest (Morlaix) and Cherbourg peninsulas transmitted the beams to the targets and cross beams were transmitted from the Pas de Calais. This gave good coverage over the southern part of the UK and well into the Midlands. The RAF code-named the beams 'Ruffian' and counter measures were code-named 'Bromide'. It took time to identify the features of the new system and to develop counter measures (Hinsley 1979, appendix 11).

The first major use of *X-Gerät* for pathfinding was on 14 November 1940 when 469 bombers made the now-infamous attack on Coventry. Ironically the first two Bromide counter measure transmitters had been installed at Birdlip in Gloucestershire and at Hagley near Birmingham during early November 1940 but played no part in jamming the pathfinders' *X-Gerät*.

By December 1940 London had ceased to be the main nightly target but raids continued on ports and inland targets with varying success

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due to counter measures against *X-Gerät* and the development of decoy fires (see below on the facing page). From January 1941 the *Luftwaffe* only attacked inland targets on moonlit nights but their main attention was given to port cities like Plymouth, Bristol, Swansea, Cardiff and Hull where beams could still be deployed with minimum interference from radio counter measures (PRO 2001, 95, para 49). In 1941 Bromide jammers were deployed to the Porlock and Shipham RCM sites to meet this threat by giving cover against *X-Gerät* for the Bristol Channel and northwards beyond.

Y-Gerät

A third development was the *Y-Gerät* or 'Wotan' with a single beam. The position of the aircraft along the beam was measured using radar techniques. Six stations were set up along the French coast between the Brest peninsula and Calais. The British referred to *Y-Gerät* by the codename 'Benito' and the associated counter measures were called 'Benjamin' and 'Domino'. The counter measures equipment was deployed after May 1941 to the RCM sites including the sites at Porlock, Shipham, Templecombe and Ivybridge giving cover over the south-west peninsula, including the Bristol Channel (TNA AIR 41/46).

Luftwaffe medium frequency radio navigational beacons

In addition to the bomber guidance systems, the *Luftwaffe* used radio navigational beacons, for example, to assist bombers returning from raids over the Britain to find their base or for maritime reconnaissance aircraft. The beacons radiated signals on medium frequencies that enable the aircraft to take bearings on two beacons and establish their position accurately. The beacons started up just before the outbreak of war and 50 were operational by March 1940. The RAF countered this system by setting up sites that received the beacon signal which was then fed down a high quality telephone line to a distant transmitter site, where the signal was re-radiated. To aircraft flying over the UK, these signals were considerably stronger than those from the correct sites and caused major navigation errors for the aircraft.

These counter measure sites were code named 'Meacon' – derived from 'masking of beacons'. There were three pairs of sites in the South West. Beacon signals were received in Somerset at Highbridge and re-radiated from a transmitter site covering the Bristol Channel at Lympsham. Other sites in Devon were at Honiton (receivers) and Fairmile (transmitters) together with Kington Magna in Dorset (receivers) with the transmitters at Templecombe in Somerset (TNA AIR 41/46).

The 'meaconing' of the beacons was not always successful due to German countermeasures, including frequency and call-sign changes. However, examples of the successes include a *Luftwaffe* aircraft landing at RAF Chivenor near Barnstaple believing that it was in France and, on 21 October 1941 a Dornier 217 aircraft returning from a shipping reconnaissance over the Western Approaches to an airfield near Paris was misled by meaconing from Templecombe into mistaking the Bristol Channel for the English Channel and flew on over southern England believing it to be over France. Further successful meaconing from Newbury caused it to fly in an easterly direction until it crossed the north coast of Kent and, finally running out of fuel, landed at Lydd. An added bonus was that the aircraft was equipped with a complete model of a new version of the *Knickebein* receiver (Air Historical Branch 1950b, 35–6). On 24 July 1941, another *Luftwaffe* Ju 88 was deceived by the Lympsham Meacon, landed by mistake at Lulsgate Bottom and was captured (Price 1977, 129).

Control of BBC transmissions

The first radio counter measure to be deployed after the declaration of war in 1939 was

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intended to prevent intrusions by enemy propagandist announcers into the gaps between BBC programmes which were a feature of broadcasting at that time. BBC announcers also gave their names before making announcements so that the public became familiar with their voices and mannerisms (Air Historical Branch 1950b, 8).

To prevent the *Luftwaffe* using British high power (over 500 watts) transmitters as navigation aids, all transmitters used by the armed forces, the GPO, civil aviation, Home Office and BBC were put under the control of the RAF so that during enemy raids broadcasting could be suspended and stations closed down. The BBC medium-wave broadcasting stations across Britain were split into groups of four with each group transmitting a synchronised signal on the same frequency making it difficult for enemy aircraft to identify where the transmission was coming from.

These stations included the BBC transmitter at Washford Cross (Figure 5.14; Wilson 1996) near the west Somerset coast which was grouped with Moorside Edge, Droitwich and Brookman's Park on the south Home frequency of 668 kHz. When enemy aircraft flew near one of the transmitters in any group, its signal would have been significantly stronger than the other synchronised transmitters and could have been used for navigation purposes. In order to prevent this Fighter Command and later 80 Wing would order the transmitter to be switched off (Air Historical Branch 1950b, 302). When transmitters were switched off, programmes continued to be broadcast from local low power transmitters at sites including Bristol, Exeter and Taunton (Collier 1957, 158). As the war proceeded, more groups of BBC transmitters were formed.

Similar measures were taken with the GPO wireless telegraphy transmitters at Portishead and at 19 other sites across Britain. In 1943 two Admiralty seaborne radio beacons including Scarweather Beacon off Swansea in the Bristol Channel were included in the system. Ireland operated a 1000 kW transmitter at Athlone but it proved difficult to arrange for it to be switched off during raids over Britain. By 9 December 1939 'spoiler' transmitters were erected by the BBC at three sites all under the control of Fighter Command including a 2 kW transmitter at Clevedon. The system was abandoned on 3 February 1941 as the Irish government had set up spoilers of their own (Air Historical Branch 1950b, 3002).

Figure 5.14: *The front of the main building at Washford Cross BBC transmitter station (Somerset County Council HER, 1983).*

In May 1944, the Washford and Brookman's Park (Hertfordshire) transmitters were held ready each night between 2330 hours and 0600 hours for counter-measures against German instructions to aircraft being broadcast from the Calais area. The operation was controlled by 80 Wing RAF through the RAF Y-Service radio intercept station at Kingsdown in Kent. If an air raid was expected, control of the two BBC transmitters could then be switched over to the RAF allowing them to jam any German transmissions. The procedure was called 'Operation Bareback' (TNA AIR 41/46).

Bombing decoys

Decoy sites (known as QL sites) used lights to simulate the reduced lighting used at depots, factories, aerodromes, railway marshalling yards and docks. They were designed to deceive *Luftwaffe* pathfinder aircraft, particularly if their

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navigation aids were being jammed, into dropping their target-marker incendiary bombs on the decoy lights, which were sited in open countryside. A second series (QF sites) of adjacent decoys was equipped with a variety of devices to simulate fires caused by the incendiary markers and thus persuade the main bomber force that this was their target. Generally, QL and QF sites were controlled from the target that they were to protect. The decoys were most effective when visibility was poor on dark nights, particularly with thin cloud or mist and were least effective on bright moonlit nights or when the ground was snow-covered.

Potential targets in Somerset that received QL and QF decoys included the Army Supply Reserve Depot at Norton Fitzwarren (SHER 44685, decoying SHER 44543), Westland's aircraft factory at Yeovil (SHER 57008, decoying SHER 55404) and the Royal Ordnance factory at Puriton near Bridgwater (SHER 12715, decoying SHER 12502). The Bristol Channel defences included QF sites to protect Avonmouth oil refineries (2), Bristol (16), Swansea (17), Cardiff (5), Newport (10) and Milford Haven (6) (Dobinson 2000, 241–89; Schofield *et al.* 1998, 271–86).

After the devastating night raids on Coventry on 14–15 November 1940, a series of massive Special Fire (SF) sites was rapidly developed to simulate the extensive fires resulting from similar mass raids on urban targets. These SF sites, or Starfish as they were later called, were controlled directly by 80 Wing, which was provided with 'the best possible information' from both RAF Y-Service and Bletchley Park. Between these two sources the *Luftwaffe* target for that night was often known in advance.

As mentioned above, the RAF Y-Service was able to follow and report the progress of an attack by monitoring bomber communications, both in flight and from their bases, as well as 'fixing' aircraft positions by using DF. This was then then combined with information from Fighter Command including radar plots, searchlight reports and Observer Corps reports. Local Starfish controllers reported the position and size of any fires produced. Taking all this information together, 80 Wing were able to decide which were the appropriate Starfish to be fired and when this should take place. Bristol got its first SF site by 27 November 1940 and a few days later on 2–3 December, two Bristol sites became the first in Britain to be used successfully during an attack by attracting a total of 66 HE (high explosive) bombs. By the spring of 1941 Bristol had five sites which were extremely successful on a number of occasions.

In 1942 after the Baedeker raids on Bath and Exeter the QF decoy protecting the Army Supply Reserve Depot (SHER 44543) at Norton Fitzwarren was moved to Castlemans Hill (SHER 44684) to the south-west of Taunton and made into a 'Temporary Starfish' to protect both Taunton and the depot. In that position it would have also given protection to the Hydrographic Office (SHER 15632). The site was closed in 1944 but later in the year, when the *Luftwaffe* developed and used more sophisticated and numerous target marker flares, 'minor Starfishes' were set up to mimic these flares should any markers be dropped near a Starfish site (Dobinson 2000, 194–95). Even as late as March 1944 the QL decoy site at Bleadon protecting Weston-super-Mare aerodrome and the shadow aircraft factory attracted significant numbers of HE and incendiary bombs during an attack on 27–28 March (Dobinson 2000, 195).

After the war the Air Historical Branch (AHB) estimated that out of the total number of bombs dropped on Britain, the 'war average' of those that were diverted by decoys was 5% but this was thought to be a very conservative estimate with the true figure being nearer 10%. Starfish sites attracted 101 recorded attacks. The AHB survey found the most successful sites were those at Portsmouth, Plymouth, Bristol, the Humber and Middlesborough. Dobinson suggests that on the basis of the 5% wastage of bombing decoys, casualties saved would be 3160 injured and 2596 dead (Dobinson 2000, 212–13). Perhaps the refusal

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of the Ministry of Defence to release files before 1979 is some indication of the success of the techniques used and their possible application in the Cold War (Dobinson 2000, x).

Camouflage and concealment

In addition to decoy sites, important targets were camouflaged to make them less visible to daylight raiders. For example, the water-storage lake for the new Royal Ordnance Factory (ROF, SHER 12502) at Puriton was created as a linear feature (the Huntspill river, SHER 11684) that could also be used to drain the levels in winter rather than a more conspicuous simple lake. As the Hydrographic Office (SHER 15632) was built on one side of Creechbarrow Hill, the 'disruptive camouflage painting' with irregular patterns in green, black and brown attempted to break up the straight edges of the building and merge it into the landscape. Westland's aircraft factory at Yeovil (SHER 55404) was camouflaged with bands of disruptive painting to make it appear from the air like rows of terrace houses.

An ambitious scheme was implemented to conceal the newly built Army Supply Reserve Depot at Norton Fitzwarren (SHER 44543). The immediate surroundings of the depot (Figure 5.15) were described in 1941 as 'open country broken up by modern housing estates … a combination of "housing" and "rural patterning" was obviously appropriate.' The scheme was 'to apply a disruptive tree patterning and to simulate houses and other buildings over parts of the main buildings. The establishment area to be broken up further by ground patterning which will be in harmony with the small woods and clumps of trees in the adjacent surroundings' (TNA WO 227/51).

Mobile smoke screens were deployed to hide key targets like Avonmouth. On 25 June 1941, Pioneer Corps soldiers arrived at Shirehampton to set up and operate a smoke screen over Avonmouth docks. The operation was the responsibility of the Ministry of Home Security through the Smoke Controller in the Central Smoke Operations Room in London. Two types of smoke generator were used: the old 'No. 24 Mark II static' or 'smoke pots' and the new Haslar mobile equipment. The 'smoke pots' had a burn time of five hours and were used in pairs to cover up to ten hours of operation. The Haslar was a mobile oil burning installation which produced biscuit coloured smoke comparable with a London smog.

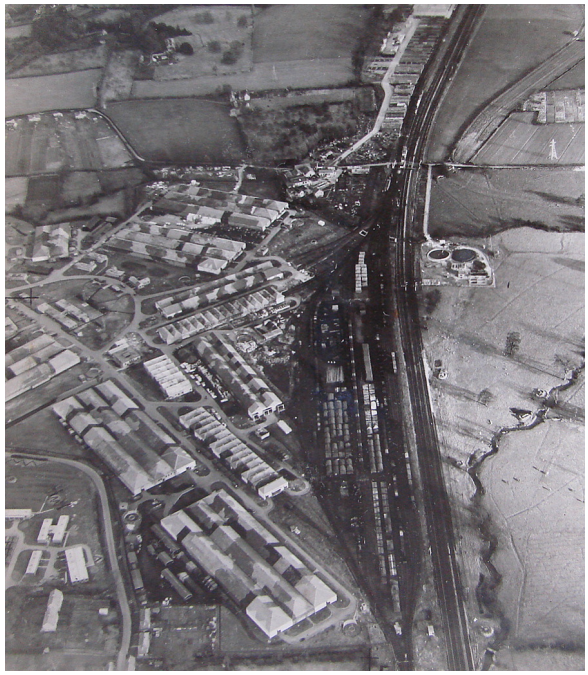

Figure 5.15: *Aerial photograph of the Supply Reserve Depot at Norton Fitzwarren, taken on 6 January 1944 to assess the camouflage scheme (TNA WO 227/51).*

By mid 1941 the Avonmouth smoke screen was laid out with an outer ring some 1500 yards (1.4km) from the target consisting of Haslar generators spaced at 85 yard (78m) intervals and an inner ring of 1000 yard (915m) radius with pairs of Mark II generators at five to ten yard intervals. Generators were deployed each night only to the upwind sector within a 60° arc on either side of the predicted wind direction, as advised by a small meteorological staff. The equipment was first used early on the morning of 5 July 1941 and by September some 2510 Mark II generators were installed.

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On 24 February 1944 in response to renewed bombing attacks and in preparation for the Normandy landings, 24 'Esso Smoke Generators' of the 79 Chemical Smoke Generating Company of the US Army were deployed at Avonmouth. By the autumn of 1944 the screens had become redundant and the manpower was deployed elsewhere. In general, the use of smoke screens to protect individual targets appears to have produced satisfactory results (John Penny, pers. comm.).

Conclusion

The air war over the Bristol Channel and its approaches over Somerset was a part of the war where technology was exploited to the full with scientific developments that were at that time state of the art, particularly in the fields of radar and what is now called electronic warfare including radio interception, code and cipher breaking, direction finding position fixing and a wide range of Radio Counter Measures. In stark contrast, First World War weapons like the Lewis gun and the 3-inch AA gun continued to give good service.

Developments in radar, in not only identifying enemy aircraft well beyond the shores of Britain, but in ground control interception using fighters with airborne radar to destroy enemy aircraft at night, was vital for defending the Bristol Channel ports against air attack. Radar technology was harnessed to AA gun-laying, searchlight direction and maritime surveillance using CD/CHL radars, but at the same time, observers still scanned sea and sky with their naked eye or binoculars and, despite the modern air defence communications, were still equipped with flares or pyrotechnics should communications fail. Somerset had its part to play in the rapid deployment of new effective radio counter measures against enemy bomber navigation aids and extensive deception measures including camouflage and decoys to minimise the effectiveness of bombing raids.

The threat from the air has also to be seen in terms of enemy reconnaissance, anti-shipping mine-laying and the potential for invasion. The proven ability of the *Luftwaffe* to land fighting troops by glider, parachute or aircraft almost anywhere with the minimum of warning brought a dimension to warfare which was a far more significant threat to the southern coastline of the Bristol Channel than seaborne invasion. Two air threats never materialised in the South West: both sides had invested heavily in protection and defence against the possibility of air-delivered chemical warfare and the German preparations to attack Bristol and Plymouth with V1 flying bomb (basically a first generation cruise missile) could have had a devastating effect on the preparations, launching and support for operation Overlord. The chemical weapons were never used and the threat of the V1 vanished soon after D-Day.

General Karl Koller, Chief of the German Air Staff at the end of the war stated that: 'The campaigns in Poland, Holland, Belgium, France and Norway had proved unequivocally how important air supremacy is in modern war' (PRO 2001, 407). Thanks to the achievements of the British air defences, the *Luftwaffe* never achieved air supremacy over the Bristol Channel or indeed over the British Isles. Without air supremacy, any invasion attempt would have been doomed to failure. The German bombing campaign was frustrated by Fighter Command by day but, at night, radio counter measures and bombing decoys were the only effective defence until the development of GL, GCI and AI radars. Despite the heavy bombing raids on Bristol Channel ports, the air defences did much to minimise and mitigate their effects and were therefore a vital part of winning this local part of the war.