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Employment of the Fighter Command in Home Defence

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Employment of the Fighter Command in Home Defence

Air Chief Marshall Sir Hugh Dowding, Royal Air Force

With an Introduction and Annotations by
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Additional Annotations by
Colonel Robert S. Staley II, U.S. Air Force

How the commander of the R.A.F.'s Fighter Command foresaw the Battle of Britain three years before it began.

In the avalanche of literature on the Battle of Britain little recognition has been given to the notable prescience of Air Chief Marshall Sir Hugh C.T. Dowding in his advance planning for it. As the commanding officer of the Royal Air Force's Fighter Command, he made a priceless contribution to the battle's favorable outcome by the way he perceived the threat long in advance and planned to counter it.

Fortunately we can now read his own words on the subject, delivered in the lecture he gave to the R.A.F. Staff College on 24 May 1937, more than two years before Britain's declaration of war against Germany and three years before the Battle of Britain began. It shows how clearly he foresaw the problems and how accurately he predicted what might happen.

To set the lecture in the context of the times, it is important to consider several key factors. Radar was in its infancy; the British system of Chain Home radar stations along its coastline employed fixed antennas and could only look outward across the sea. It was still so secret that the name itself was camouflaged as "R.D.F." and Dowding declined to discuss it in any detail even to such a professional military audience. Identification Friend or Foe (I.F.F.) was also in its infancy, and the "Pipsqueak" method of tracking friendly fighters across England behind the radar antennas was still in the embryo stage. Nevertheless, the Battle was fought virtually as predicted, except that a fourth fighter group was added later to the three envisioned by Dowding, in order to give added protection to Scotland and the north of England from German raids originating in occupied Norway.

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The full text of the lecture follows. We are indebted to Wing Commander John R.C. Young, AFC, R.A.F. (Ret.) for obtaining it from the British Public Records Office for the benefit of his own students in a course on the Battle of Britain at Corpus Christi College, Cambridge University. Wing Commander Young was himself a Hurricane pilot in the Battle.

Lecture delivered by Air Chief Marshall Sir Hugh C.T. Dowding, K.C.B., C.M.G., A.D.C., at the R.A.F. Staff College on 24 May 1937

I HAVE BEEN ASKED to lecture to you today on the employment of the Fighter Command in Home Defence. I do not propose to go into details which will overlap with what you will see and hear for yourselves when you visit Uxbridge.[1] I propose to theorise a little upon Home Defence in general, but I want to emphasize that any opinions I give you, as opposed to facts, are personal only, and do not necessarily reflect the policy of the Air Ministry.

The air defence of this country can be finally assured only by victory over the enemy, and conversely it can only finally fail by our defeat.

It seem logical then to begin by considering how it would be possible most quickly to lose a war.

This might come about through panic caused by indiscriminate attacks on London, or by immediate paralysis of our food supply.

These two occurrences, separately or in conjunction, might possibly defeat us in a fortnight or less.

If we can be secured against a snap decision of this kind we could be defeated only by the slower process of exhaustion of our resources in equipment, personnel, food, raw material, sea transport, or credit.

London, in addition to being our largest centre of population, is also the focal point of the machinery of Government, and is the main centre for reception and distribution of the imported food supplies which the nation requires for its existence. The defence of London is, therefore, the first and most important task in the defence of Great Britain.

Supposing that we can protect ourselves against these primary and crucial dangers, what circumstances should we next consider?

John Monsarrat, while attached to the USS *Langley* (CVL 27) from 1943 to 1945, was a pioneer in shipboard air intercept control. He is the author of *Angel on the Yardarm: The Beginnings of Fleet Radar Defense and the Kamikaze Threat* (Naval War College Press, 1985).

Colonel Staley is a member of the Strategy faculty at the Naval War College.

I think we must try to visualise the mentality and the cold logic of the modern Totalitarian State. War waged from opposite sides of the English Channel depends predominantly on material resources. It is possible to build up industry to a peak of productiveness for war material, but it is impossible to remain at that peak point. Aircraft output on a scale calculated to deal with war wastage can not possibly be absorbed in peace time.[2] Relaxation is inevitable. Capital becomes idle. Trained men lose their skill. And mass production machinery becomes obsolete with the obsolescence of the material it has been designed to produce.

We must expect, therefore, that the Totalitarian State will fix its own date for a war five or six years ahead, work to this date, and then declare war on any or no pretext.[3]

It is therefore more than probable that we should find ourselves at a disadvantage regarding industrial mobilisation on the outbreak of war, and this brings me to the proper objective of an air force.

Now although I have said that we must be prepared for attacks in maximum strength on London, and on our food supplies, it by no means follows that these would be the first objectives of an enemy, and we must be prepared for an alternative.

Imagine if you can, that I am a Dictator of a European country. I should think somewhat on the following lines:

"Whatever may be the ultimate best air objective to bring victory, the attainment of that objective will be hampered to a greater or less extent by the enemy's air force.

"His fighters will destroy my bombers in the air, and his bombers will destroy mine on the ground, and my air force may suffer such heavy casualties that I shall fail to attain my objective.[4]

"I will therefore start by attacking my enemy's air force at his aerodromes, his reserve storage depots, and his factories. I will paralyse his air force and keep it paralysed.[5]

"I can then at my leisure adopt any of the methods of frightfulness which are most likely to bring victory in the shortest possible time."

I say that we must be prepared for this attitude.[6] That is the attitude which we ourselves should adopt, and further, that is our only hope of reducing the balance against us when war has been declared by the enemy at the time for which he has prepared, i.e., the moment when his industrial mobilisation is complete, and he has reached the point of peak production.

Suppose that the efficiency of our defensive equipment provides (as I believe it will provide) an unpleasant surprise for the enemy. Suppose that an average interception involves a fifty percent loss for an enemy formation.[7] Suppose that

the balloon barrage takes heavy toll of his low-flying machines, and the anti-aircraft guns contribute their share.

We have exposed our hand: what do we gain? A respite only. Fighters and guns can shoot down only those bombers which present themselves as targets in the air. The enemy pauses while he armours his bombers, puts cutters on his leading edges, or does whatever is necessary to discount the factors in which we have shown superiority, and then returns to the attack.

Unless in the meantime the bombers are systematically destroying the enemy's machines, reserves, factories, and fuel supplies, we can never ensure home defence by the operation of the Fighter Command and the army units associated with its work.[8]

Further, the nation which first recognises the vital necessity for the adoption of this policy may well get such a start that the enemy who has begun by attacking less fundamental objectives will never be able to recover, and will lose the capacity for carrying out any major operation in the air for the remainder of the war, which in these circumstances is likely to be a short one.[9]

Having thus given vent to a declaration of my conviction on this subject, I will turn to those aspects of the air defence of Great Britain which are more particularly my responsibility.

The first point to realise with regard to the operations of the Fighter Command is that it can never take the initiative. This rests inevitably with the enemy.

We have to guess not only what his objectives will be, but how he will attack them.

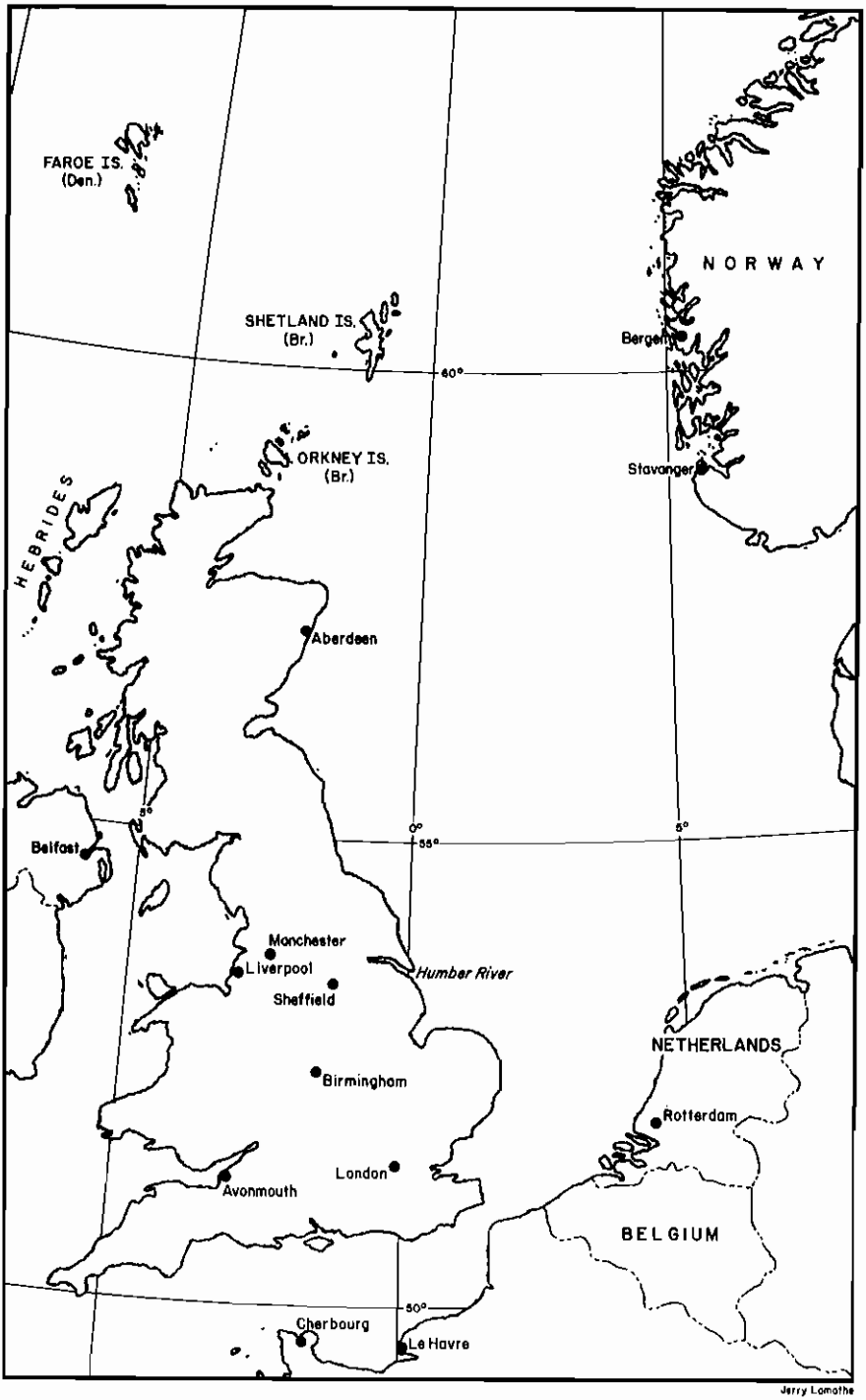
Will he send over single machines or very small formations, trusting to numbers to confuse the defence? Will he send formations in medium strength capable of self-protection, and at intervals calculated nicely to find the defenders on the ground refuelling? Or will he depend upon monstrous hammer blows delivered once every twenty-four hours by every available machine?

I do not know. Nobody knows. But we must be prepared for all possibilities.[10]

If the enemy is wise he will probably adopt no routine method but will attempt to obtain surprise by a judicious variation in accordance with visibility and weather conditions.

All I can say is that we must be prepared for anything, and that our dispositions and tactical methods must be flexible and adaptable instantly to counter variations in methods of attack.

Until recently one might almost say that we have had no scheme for the air defence of Great Britain—only for the defence of London. If you will look at the map[11] you will see the Aircraft Fighting Zone, and that at the present moment only those Sectors from Duxford to Tangmere are effectively organised as regards aircraft; and the provision for searchlights is little more than adequate to cover the Thames estuary and its immediate neighborhood.



Theater of the Battle of Britain

I understand that you are shortly to visit Uxbridge and Northolt where you will see all the details of a Group and Sector organisation. The explanation which I propose to give you now will, therefore, be a general outline only to enable you to appreciate how the details of the Group and Sector organisations fit in to the general scheme.

The Aircraft Fighting Zone is divided up into Sectors, each with a Sector Headquarters located at an appropriate aerodrome.

The Zones will be covered with a network of searchlights which alone, for the time being,[12] make night fighting possible except in conditions of exceptional visibility.

You will see from the map that this Zone is to extend uninterruptedly to the north of Newcastle, and that a separate lighted Zone is to be created in Scotland round Edinburgh and Glasgow.

You will notice that the inner edge of this Zone curves round the eastern and southern outskirts of London. The circle which covers the bulk of London constitutes the Inner Artillery Zone, where guns are the primary weapon of defence. Our own fighters normally keep out of this Zone except when in direct pursuit of an enemy formation.[13]

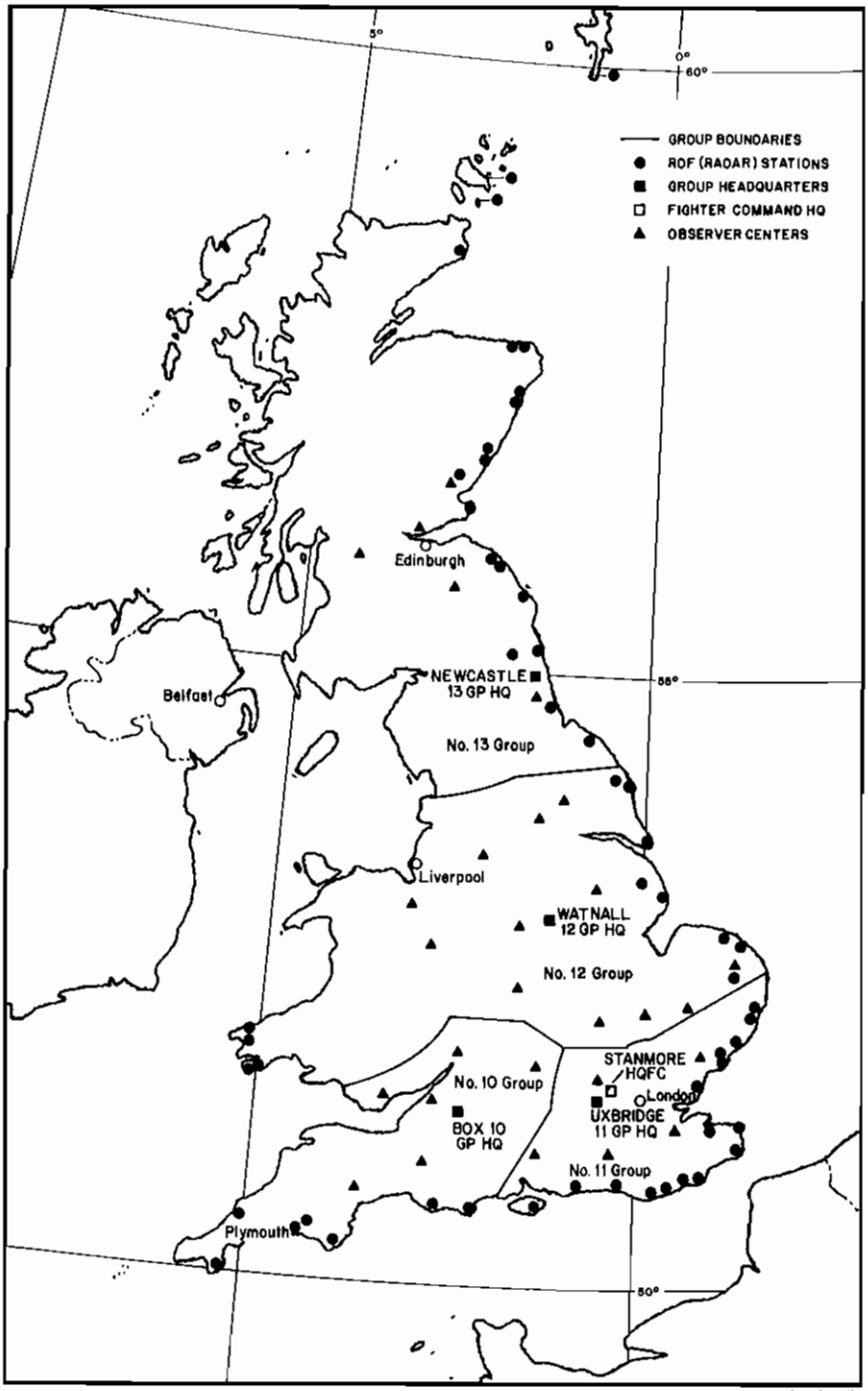
Until recently the policy was to create also an Outer Artillery Zone, east of the Aircraft Fighting Zone, but the desirability of intercepting incoming raids eastward of the Fighting Zone, together with the difficulty of providing the necessary number of guns, has led to the abolition of this Outer Artillery Zone.

Instead, it is now proposed to put a number of guns along the Thames and its estuary for the protection of the London Docks, and this policy has been accepted in spite of the difficulties of operating guns and aircraft in the same Zone.

The whole defensive line will be divided into three Groups[14] with Headquarters at Uxbridge, Hucknall and Catterick, and with dividing lines at the Humber and just south of Duxford. Sector Headquarters will be at Edinburgh, Usworth, Catterick, Church Fenton, a new Station "A" near Gainsborough, Digby, Wittering, Duxford, North Weald, Hornchurch, Biggin Hill, Kenley and Tangmere. Pending the construction of New Station "A", Debden will be substituted and the Sector boundaries slightly re-arranged as requisite.

Broadly speaking, the policy will be to have two Regular squadrons at each Station in peace time. On mobilisation an Auxiliary Squadron will move into seven or eight of these Stations, but four of the Stations so reinforced will house a Field Force Squadron in peace time. If, therefore, the Field Force Squadrons are withdrawn on mobilisation, Sectors will still normally have two squadrons each, and those immediately around London three squadrons.

It is important that more accommodation than is required under any rigid plan must be available in order to secure flexibility for the defending force. For instance, it is desirable that Northolt and Hendon should be available in war time so that squadrons may be brought down from the line further north in the



Air Defences of Great Britain, August 1940

event of the enemy beginning hostilities by intensive mass attacks on London.[15] In the same way it is important that extra accommodation should be available in the Stations protecting the Midlands in case the enemy should find his attacks on London too expensive and transfer his attention to large manufacturing towns such as Birmingham, Manchester, or Sheffield.

There is another possible form of attack which I think deserves closer study than it has received up to the present so far as I am aware.

I refer to the attack of our food and supply ships at sea.[16]

I believe that we can protect the London Docks. By this I do not mean that we can absolutely prevent all attacks on the Docks or damage to them and to the shipping therein, but I mean that we could make such attacks so expensive to the enemy that he would be unable to persist in them.

This, however, is only an opinion, and it remains a matter of the highest importance to perfect arrangements by which shipping can be diverted to western ports such as Avonmouth and Liverpool,[17] and to organise transport for the adequate distribution of supplies from those centres instead of from the London Docks.

I understand, however, that there are limitations to what can be done in this respect, and it seems probable that an appreciable percentage of our shipping will always have to use the Thames estuary if the population of London is to be supplied with tbe necessities of life.

These ships will have to come up the Channel and round the North Foreland, and if the enemy should find that attacks on London and other manufacturing districts were unduly expensive, he might well decide to transfer the bulk of his offensive power to these supply ships.

It seems to me that our shipping will, broadly speaking, be as open to submarine attack as it was in the last war, and it will now have to face the additional danger of attack from the air.

The convoy system, which did so much to reduce the submarine danger towards the end of the last war, will operate to some extent in favour of this new form of attack since it will concentrate the targets in convenient masses,[18] and will assist the enemy to differentiate between our own and neutral shipping.

Convoys will, of course, presumably be accompanied by ships carrying anti-aircraft guns, but a convoy covers as a rule a considerable area, the whole of which the guns may not be able to protect.

The limited endurance and navigational facilities of fighters would render them unsuitable for operations far out to sea, but it appears that they might be called upon to protect shipping in the Strait of Dover, and I should certainly regard this as one of my responsibilities.

I have no doubt that the larger question of the protection of our sea borne commerce from air attack forms the subject of discussions here, and engages the attention of the proper authorities.

There is one other form of attack the possibility of which we must keep in mind, although its probability is not very great at present. I refer to the possibility of invasion either on a large scale by sea,[19] or on a small scale by means of troops landed or dropped by parachutes, from aeroplanes.

The former is, in my opinion, not a serious danger so long as the troops landed have to rely upon shipping for communication with their base.

It is early yet to draw conclusions from the Spanish Civil War, but it does seem that the Government invasion of the Balearic Islands was entirely defeated by quite a small degree of air opposition, and that the expedition had to be abandoned owing to the impossibility of obtaining a safe landing area and securing the communications with the mainland.

We must look further forward to a time when an invading force may have its essential supplies carried by air, in which case the question would have to be reconsidered. This is not practical politics at present, and I shall spend no further time discussing it.[20]

A form of invasion or raid which is perhaps less visionary, would be the landing or dropping of several hundred men at an isolated aerodrome. Their object would be to destroy the aircraft and technical buildings before any body of troops could be brought to the spot, and this raid would be followed by another after a short interval, which would drop another relay of men at a second aerodrome and pick up the original lot from the first.

This form of attack might be delivered particularly against aerodromes because it would otherwise probably be impossible to re-embark the troops after they had effected their object.

I do not think that this is a particularly likely form of attack, but it is undoubtedly a possibility.[21]

I must next explain the system upon which we rely to obtain advance information of the enemy's attacks.

The basis of this organisation consists of the Observer Corps, which is composed of volunteers enrolled on a Special Constabulary basis.

The country is covered with a network of Observer Posts, connected by telephone with Group Centres. These Centres collect and filter the Observer Posts' reports of what they can see and hear, and the resulting information is passed to the appropriate Group and Sector Headquarters.

Each Group and Sector Headquarters has a map upon which the course of enemy raids, together with information concerning their height and numbers, is plotted by means of coloured counters. The counters are coloured to correspond with the time at which the observation was made, and this enables stale information to be removed from the map after a period of ten minutes.

The Group and Sector Operations Rooms are both tactical organisations from which orders can be issued to the Sectors and Squadrons respectively, and complete information is kept at the Group Operations Room concerning the

availability of all units and their state of readiness, together with the rough position of fighter formations actually in the air.

In addition to the Observer Corps,[22] there is another means of obtaining information of the enemy's approach. I regret that I can not give you much information about this system because its existence is very secret, and I must specially ask all present here today not to refer outside this College to the existence of this organisation which has been christened "R.D.F."[23] Suffice it to say that by this means (which has superseded the "Sound Mirrors" previously relied on) we are able to detect the approach of aircraft over the sea up to a distance of sixty miles or more, and, in the absence of any congestion, to plot their courses with fair accuracy.

The information from R.D.F. centres will be transmitted to Group Operations Rooms and to the table at my own Headquarters.

Now as to the means of making use of the information which we receive regarding the enemy's approach, there are two broad alternatives.

(a) When the number of enemy formations, or individual aircraft, is so great that separate tracks can not be kept on maps in the various Operations Rooms, squadrons and flights are sent up to patrol lines which are allotted to them in the Sectors of the Aircraft Fighting Zone.

(b) When the enemy formations or aircraft are sufficiently few to be shown separately on the Operations Rooms' tables, squadrons or flights are sent up to intercept definite raids. This, of course, is much more satisfactory and economical than (a) if the saturation point of the operations tables has not been reached.[24]

Remarkable progress has been made in the art of intercepting raids in the last eight months, and I should like to pay a tribute to the scientific committee, presided over by Sir Henry Tizard, whose ideas have taken the most practical shape after a period of experiment at Biggin Hill.[25]

The tendency at first was to design complicated scientific instruments to work out the mathematical problems involved, and to solve the various triangles of velocities in three dimensions, but practical experience has shown that the technique of plotting courses on a black-board, and directing the fighters by R/T[26] from the ground, has produced results of rather unexpected accuracy. The staff at Biggin Hill have now reached a stage where thirty interceptions without a single failure were made against incoming raids, although the latter were permitted to alter their course and height. I hope you will see this system in operation when you visit No. 11 Group.

One of the handicaps in making distant interceptions has been the limited range of R/T communications between ground and air, and until recently it has not been practically possible to control the fighters, or to D.F. their positions, at ranges in excess of twenty-five to thirty miles. Another trouble was that the aircraft sets were continually wandering off their proper wave-lengths and, as tuning is exceptionally sharp with short waves, they were constantly losing

Air Chief Marshall Sir Hugh Dowding, R.A.F.

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touch. A comparatively simple new method of stabilising the wave-length by the introduction of a quartz crystal has put up the range of our existing R/T sets to something like eighty miles, in addition to stabilising them completely.[27]

It is proposed to have three R/T D.F. Sector Stations in each Sector, one at Sector Headquarters and two others thrown well out towards the sea coast.[28] This will ensure that two of the three stations are always well situated to give a D.F. cut, and one of the forward stations can communicate with the aircraft in positions where it would be out of range of its home station.

I must now say a word about my own operations table, which differs essentially from Group and Sector tables in that it is strategical and not tactical in character.

The principal difficulty which has arisen through this new power which we now possess of detecting aircraft at a distance over the sea, is to differentiate between enemy raids, our own returning formations, and coastal reconnaissance and patrols engaged in their normal activities over the North Sea.

This matter still forms the subject of discussion and experiment,[29] but it seems probable that the solution will lie partly in allotting "safety lanes" to outgoing and returning bombers, and partly through a system of wireless challenge and recognition signals operating between returning bombers and Direction Finding Stations specially allocated for the purpose. It is also probable that a Bomber Liaison Officer will be permanently employed at my operations table. He will be familiar with the "raid table" for each day, and will be in direct communication with Bomber Groups. The Admiralty have also asked to have a representative permanently stationed in my Operations Room.

Everything at present is in an experimental stage, since my Headquarters was only formed last summer,[30] but the present intention is that no executive or fighting orders shall normally be issued from my Headquarters, and the functions of my Operations Room staff are firstly to differentiate between our own and enemy formations, and to allot an enemy formation to the appropriate Group when there seems to be any doubt as to which Group should deal with it. The course of enemy raids which have penetrated beyond our Fighting Zone will also be plotted on my map so that Groups may not be taken by surprise by the unexpected approach of an enemy formation from the westward. And finally, my map will form the best possible means of giving to the Home Office authorities the information which they will require for the issue of raid warnings.

The requirements of the Home Office in this respect are somewhat pressing, and we are in close collaboration with them in order to evolve a workable scheme. In brief, they want the country divided up into a number of warning areas and warning districts, and that each district which is within a certain distance, measured by minutes of flying, from the enemy raid shall receive an advance warning. Soon afterwards, if the course is unchanged, they will receive an action warning, followed in due course by a signal "Aircraft Passed." There

is a fourth signal—"All Clear"—but this depends principally upon the local authorities themselves because they alone know whether the effects of any gas which may have been dropped by the enemy have been neutralised.

It seems clear that a compromise must be effected between big warning districts and consequently unnecessary alarms, and small districts where the system would break down through the physical impossibility of passing on the messages involved.

I must next say a few words about the balloon barrage which is now in the process of formation. Much of the material has already been delivered, and Regular personnel are being trained in preparation for the further training of Auxiliaries.

Opinions vary a good deal as to the probable physical effect of a balloon barrage, but there is no doubt that its moral effect will be great, and it will constitute a great deterrent to one particular method of attack which is especially difficult to deal with. I refer to the "hedge-hopping" attack which comes in just clear of the tree tops. The main objection to this, of course, is the great difficulty of navigation unless a large target such as London is being attacked, or unless some clearly defined feature like a river, railway line, or arterial road leads in the desired direction. If these difficulties can be overcome, the "hedge-hopping" raid absolutely defeats anti-aircraft guns, and will reduce very largely the number of effective observations from the Observer Corps. Properly camouflaged aircraft, flying very low down, are extremely difficult to pick up from the air, and when picked up are difficult to attack.[31]

Technical development of balloon barrages is proceeding intensively, and it is possible that in a comparatively short time the balloon will be a more effective deterrent than it is at the moment.[32]

In conclusion I must refer briefly to measures of passive defence. The Home Office is directly responsible for these, but of course they form part of the air defence of Great Britain and I naturally take a great interest in them although they may not be my direct responsibility.

The main dangers to be guarded against are fire, bomb explosions, and gas, probably in that order of importance.[33]

Incendiary attacks have the unique property of enabling the enemy to utilise for purposes of destruction more material than he actually carries in his aircraft, and in my opinion it is the greatest danger which the civil population has to face. A single modern bomber might distribute 1,000 small incendiary bombs, and as the ratio of open to built-over ground in London is as seven to two, a single machine might initiate something like a hundred fires as the result of one raid. Multiply this by the number of raiding machines and you will see that there is a serious danger that groups of individual fires, if not promptly dealt with, will unite and cause a conflagration which will be beyond the control of any firefighting organisation which we are likely to be able to provide. The

importance, therefore, can not be overestimated of educating householders, managers of factories, etc., in the means of dealing at an early stage with fires caused by incendiary bombs. It will be necessary also largely to increase the existing firefighting organisations, and to ensure that they are available quickly and in adequate numbers at places where they are required.[34]

You may have seen from some papers that the Home Office are dealing with this problem but that they are not having an altogether smooth passage. As is not unnatural, municipal authorities are inquisitive as to the contribution which the Government proposes to make towards the provision of facilities additional to peace time needs.

A pamphlet giving instructions to householders is also in preparation but has not yet been completed.

Other instructions dealing with shelter against bombs, and precautions against gas, are also in course of preparation.

These much needed activities have only recently been set on foot and, although much overdue, are now going ahead satisfactorily. A sub-committee of the Committee of Imperial Defence has been specially constituted to deal with the subject, and one of my staff is a member of it in order that I may be kept in touch with progress, although as I have already said, the direct responsibility lies with the Home Office.

Notes

1. Uxbridge was the location of 11 Group Headquarters, just west of London. The purpose of this visit was to show staff officers how the Operations Room was organized at Group level. This particular 11 Group Room has been replicated at the R.A.F. Museum at Hendon.

2. Between 10 July and 1 November 1940 the R.A.F. lost 902 fighters in the Battle.

3. While it is true that Hitler began his buildup of the German military soon after coming to power in 1933, there is no evidence that he had planned to hit Britain "five or six years ahead" of 1940, or that he had planned to fight Britain at all. In fact he had quite possibly planned to initiate the war against Russia in 1943. In any case, the war Dowding is anticipating occurred at least two years earlier than called for in German plans.

4. German aircraft losses in the same period were 1,598. Overall in the entire Battle the loss ratio was 1.8-to-1 in favor of the R.A.F.

5. All of which the Luftwaffe attempted to do.

6. Dowding missed (or perhaps chose not to mention) one element of the dictator's plan, and that entailed the establishment of Luftwaffe bases across the English Channel in France, Belgium, and Holland. Dowding's own thinking, and his musings on Hitler's thoughts, may have failed to envision German fighters over British soil; on the other hand, he may have simply omitted what would have been a sensitive matter for future European allies.

7. Given fighter protection and the normal heavy cloud cover over England, German losses were far less than fifty percent. In a fairly typical example, on 15 August the Luftwaffe put up 1,790 aircraft (520 bombers and 1,270 fighters) but lost only 76 aircraft—slightly over four percent.

8. Bomber Command's targets also included transportation centers, submarine pens, and concentrations of invasion barges. The British counter-attack, accordingly, was not limited to German air capabilities.

9. Dowding here echoes a fundamental claim of Douhet's theory—that aerial attack, if conducted properly, results in short wars. And his comments on the necessity of gaining air superiority certainly did ring true in the short campaign leading to the fall of France.

10. The Luftwaffe tried all these varions tactics during the Battle.

11. An earlier map, not to he confused with the simplified version used to illustrate this article.

12. Pending the development of A.I. (Airborne Intercept) radar.

13. Some R.A.F. fighters were shot down or damaged by British anti-aircraft fire, but the concept was correct and was constructive in practice.

14. By the time of the Battle, a fourth group (numbered 13) had been added, and proved its worth in mid-August when it repelled a large raid on Scotland from Norway with such heavy German casualties that no other was attempted. The Group and Sector Headquarters were as follows:

10 Group at Box, with Sectors at Middle Wallop and Filton. 11 Group at Uxbridge, with Sectors at Northolt, Hornchurch, North Weald, Debden, Kenley, Biggin Hill, and Tangmere. 12 Group at Watnall, with Sectors at Duxford, Coltishall, Wittering, Digby, Kirton-in-Lindsay, and Church Fenton. 13 Group at Newcastle, with Sectors at Catterick, Acklington, and Turnhouse.

15. Reinforcements for 11 Group's interceptions of massive raids were often requested from 10 Group and 12 Group.

16. The earliest attacks by the Luftwaffe were aimed at shipping in the English Channel and the Channel ports.

17. As was done.

18. As the Murmansk convoys so sadly proved.

19. Hitler twice postponed the date of his planned invasion, and put it off indefinitely on 17 September after the Luftwaffe's devastating losses on the 15th.

20. Rather than read any political meaning into this phrase, "practical politics"should be read as a British colloquialism. Dowding simply meant that aerial invasion was not practical. He had not seen what the Germans were yet to do with air transport and paratroopers over Norway.

21. While this form of attack did not occur in England, it did in Norway and later in Crete.

22. The Observer Corps had personnel throughout England and was an important element in the plotting of raids at Group and Sector Headquarters. In his report of 20 August 1941 Dowding said of it: "Suffice it to say that this loyal and public-spirited body of men had maintained their watch with admirable efficiency since the beginning of the war and throughout a winter of exceptional severity. It is important to note that, at this time, they constituted the sole means of tracking enemy raids once they had crossed the coast line . . . . Without [the Observer Corps] the Air Raid Warning systems could not have been operated, and Inland Interceptions would rarely have been made."

23. R.D.F. was generally known by the Germans to stand for Radio Direction Finding, and was the "cover name" given to radar by the British in the early period of its highly secret development. In this instance Dowding specifically refers to radar. Dowding himself obtained the first 10,000 pounds sterling to fund its development.

24. These alternatives were routinely followed by controllers in the Operations Rooms, just as Dowding prescribed. Throughout the Battle it was Dowding's policy to commit fighters as sparingly as practical in the interception of individual raids. This policy caused severe friction with Air Vice-Marshall Sir Trafford Leigh-Mallory, commanding 12 Group, and Squadron Leader Douglas Bader, commanding the Duxford Wing. These officers favored scrambling much larger numbers of fighter squadrons to counter incoming raids. Air Vice-Marshall Sir Keith R. Park, commanding 11 Group, opposed Leigh-Mallory on this issue because of the long time it took for large Wings to take off, rendezvous, climb to altitude, and reach the raid before it dropped its bombs. He reported that of the ten large fighter formations sent from Duxford into 11 Group in October, nine made no interception and the tenth destroyed only one ME-109.

25. While the Battle was being fought, Tizard led the British mission to Canada and the United States to share the fruits of scientific research in the U.K. Among the invaluable developments he disclosed were the cavity magnetron, a vital key to developing U.S. radar, and the power-driven revolving gun turret for bombers.

26. Radio telephone.

27. These crystal-controlled radios were in use throughout the Battle of Britain.

28. These radio-telephone direction finding stations, coupled with improved radios in the fighters, made possible the tracking of R.A.F. fighters by the system known as "Pipsqueak." Under this system the aircraft of Fighter Command were equipped with radio transmitters that automatically sent a signal to the Direction Finding Stations during thirteen seconds of every minute.

29. By the time of the Battle, the R.A.F. had I.F.F. (Identification Friend or Foe).

30. At Bentley Priory in Stanmore. Dowding was eventually elevated to the peerage as Lord Dowding of Bentley Priory.

31. The early detection of low-flying raids was achieved by the installation of C.H.L. (Chain Home Low) radar stations, since the regular Chain Home stations could not detect low-flying aircraft. However, once a low raid was over England, it was up to the Observer Corps to track it.

32. In his report following the Battle of Britain Dowding said of the barrage hallons: "It is true that their material results, in terms of enemy aircraft destroyed, were not impressive, they suffered staggering casualties in electric storms, and had brought down a number of our own aircraft; on the other hand, they exercised a very salutory moral effect upon the Germans and to a great extent protected the vital objectives, which they surrounded, against low-altitude attacks and dive-bombing."

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33. This forecast proved to be precisely accurate.

34. Under the direction of the Home Office and local authorities, the civil defense played an enormous role in wartime British life, including such activities as air-raid alarms, blackout patrols, fire-fighters and fire-watchers, Home Guards, air-raid shelters, rescue parties, gas mask distribution, rubble removal, and evacuation of children.

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Our cover illustration depicts, as artist Bob Hobbs describes it, action of "the evening on September 7th, 1940. A huge wave of bombers descended upon London to attack the docks and the surrounding area. British fighters defended the city as best they could with the aid of ground-based searchlights, anti-aircraft guns, and barrage balloons." In the foreground Supermarine Spitfire Mark 1A fighters of Royal Air Force 19 Squadron engage Heinkel HeIII bombers over the Thames, just west of Tower Bridge.

This is Mr. Hobbs's second recent cover for this magazine: his depiction of the Battle of Tsushima appeared in Spring 1991. A navy veteran and now an illustrator for the Naval War College, he has been a professional artist for over sixteen years. His work has appeared in military, civilian, and commercial publications across the nation and has been exhibited in Honolulu, Japan, New York City, and Newport.