DID RADAR WIN THE
BATTLE OF BRITAIN?

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In August 2006, the reported conclusions of three historians from the Joint Services Staff Command College, Shrivenham, that the Royal Navy had won the Battle of Britain caused an uproar in the British national media.¹ The sensational headlines seem to have embarrassed the historians into writing a set of three papers for the Royal United Services Institute to modify the extreme assertions of former journalist Brian James in the magazine History Today.² The significance of this affair is not whether James misrepresented them but lays in the inability of the British public to tolerate any revisionism relating to the events of 1940—especially anything dimming the spotlight on that gallant band of fighter pilots known as “The Few.” The organization most responsible for deterring an invasion in 1940 was the Royal Navy.³ The heroism of “The Few” was relevant, but the current obsession with British national identity—a concept fundamental to the nation’s role in the Second World War and 1940 in particular—denies credit to the broad base of participants. As the Shrivenham historians have argued, we need a more holistic approach to the defense of Great Britain in 1940.

When Battle of Britain ace Peter Brothers responded to the James “revelations” via The Daily Telegraph, he argued that “the first thing that won the Battle of Britain was radar.”⁴ Indeed, this was the claim originally made by Radio Direction Finding (RDF) pioneer Robert Watson-Watt (1892–1973) to Archibald Sinclair, secretary of state for Air, in December 1940 and subsequently accepted with few

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1. Brian James, “Pie in the Sky,” History Today 56.9 (September 2006): 38–40. The historians are Dr. Andrew Gordon, Dr. Christina Goulter, and Professor Gary Sheffield.


reservations by well-known authors such as H. Montgomery Hyde ever since. After all, the only alternative system to one based on early warning was to keep large numbers of aircraft constantly airborne on potentially wasteful standing patrols. Newspaper writers waxed poetic during the battle’s sixtieth anniversary celebrations, while Phil Craig praised Dowding’s leadership and claimed that the radar chain he helped to create “worked as he dreamed it would.” However, most authors of the air campaign struggle to explain how a system of aircraft detection so fraught with problems right up to July 1940 should have everything miraculously snap into place when the fighting intensified over the next three months. If the key to that success was the RDF chain linked to the system of Command and Control, then one is likely to conclude that only the heat of action welded the organization together as an effective tool.

Even so, it is not disreputable to have a view that sharply contradicts the account skillfully marketed by the Air Ministry in 1941 in their best-selling pamphlet The Battle of Britain; August–October 1940. There is now reason to question the true effectiveness of radar, or RDF, as it was misleadingly known in 1940, together with the system of command and control that bore the name of Air Marshal Sir Hugh Dowding, head of Royal Air Force (RAF) Fighter Command. As the perceived victory of Fighter Command has determined the direction of those writing about the “Dowding System,” it must have been difficult to envisage the latter as less than a resounding success. Yet the documents casting doubt on this aspect of the Battle of Britain are easily accessible in The National Archives. They are not emphasized because they do not fit the paradigm.


8. RDF can be confused with the direction finding methods used to obtain intelligence by listening to enemy radio transmissions. The term may have been a deliberate ploy to confuse the Germans.

No reason exists to doubt the effectiveness of the “Dowding System” later in the war. The system became truly formidable once the technicians solved the teething problems, built a second inland chain, and installed the revolutionary cavity magnetron as the basis for a new radar system. However, when technological systems replace manual ones in large organizations, a period of organized chaos often ensues. This period of transition may well have extended throughout the Battle of Britain.

Documents from The National Archives and other published primary and secondary sources will help to address these matters. An outline of the Dowding System and official reports on the training and efficiency of personnel and the calibration of RDF stations may also give further clarification. Reference to the controversial Wing Commander H. R. Allen, DFC, as the most ferocious critic of the RAF’s campaign has relevance despite F. K. Mason’s criticism for alleged shortcomings, such as his “bland ignorance of aircraft design,” and for indulging in a typical junior officer’s fantasy of handling military campaigns better than their senior commanders. However, Allen was also a successful Battle of Britain ace whose abilities during the war led to his command of 66 Squadron. This unit saw considerable action within the embattled 11 Group. For Allen, the early warning system was unreliable, his logbook showing that “only on 50% of occasions did my squadron achieve an interception after the order was given.” For him, the most dependable information came from the Royal Observer Corps (ROC) in clear weather. If one then starts to doubt the effectiveness of the Dowding System in 1940, what other motives existed for making such extravagant claims on its behalf? Finally, the way these deficiencies affected the way air battles were fought is shown here.

Dowding did not invent the system of aircraft control for early warning and interception using special operations rooms, dedicated staff, and tables to plot the air raids, although he played a major part in their later development. Rather, Brigadier General E. B. Ashmore organized information gathering and dissemination in World War I through a central command structure with many resemblances to Dowding’s later systems. These included control rooms displaying information in visual form on special tables and a primitive form of radiotele-


12. Ibid., 59.
phone linking aircraft to ground control. Early warning depended on visual observation from high-flying aircraft, lightships, and ground observers, sometimes with the assistance of sound detection equipment. The range was more limited than RDF could later provide, but compensated for by the fact that airships and biplane heavy bombers were much slower than later Luftwaffe bombers. By September 1918, it took only thirty seconds for operators to plot the course of enemy aircraft after first sighting.

Ashmore’s system was never fully tested, but it helped destroy six night-flying German bombers on 19 May 1918, representing an achievement that even the refined system of 1940 could not match. Despite postwar atrophy, Ashmore’s system provided an organizational model that was greatly refined and expanded between the wars. As head of Fighter Command, Dowding played a large part in supporting the development of RDF. Indeed, as Zimmerman has noted, Dowding deserved great praise for supporting the development of RDF, especially after the failures of 1936/37. Zimmerman admitted to some errors of judgment on Dowding’s part but argued that they “pale in comparison to his central role in developing the Dowding System.”

The Notes on the Air Defence of Great Britain describes a chain of RDF stations on (or near) the coast directly connected by telephone landlines to Filter Rooms in various geographical locations. Chain Home (CH) represented the main chain of RDF stations and Chain Home Low (CHL) existed to counter low-level incursions. Aircraft positions over the sea were plotted, and their numbers and height were estimated and passed to the relevant Filter Room for plotting on the Filter Room Table. The Filter Room staff would then have to differentiate between friendly, hostile, and doubtful aircraft. This information would pass simultaneously to the Command Operations Room (Fighter Command Headquarters, Stanmore) and the Group Operations Room and the Sector Operations Room. The data would then appear on the Operations Rooms Tables of all these establishments. Observer Corps Centers would also receive the information to enable further raid monitoring after crossing the coast. A web of Observer Corps posts


15. Ibid.

situated approximately eight miles apart had telephone links to Observer Corps Intelligence Centers that would plot the aircraft on their own Center Tables. These would filter out friendly aircraft and pass the data on to Command, Group, and Sector Operations Rooms, which would plot accordingly.17

Therefore, the Command Operations Room at Stanmore would have an overall view of the situation. Air-raid warnings issued from here, and liaison was maintained with the Admiralty and Home Office. Convoys were also plotted here with information from naval liaison officers. The next tier comprised six Group Operations Rooms where the Air Officer Commanding (AOC) would control his squadrons. From here, the AOC instructed sectors to intercept specific raids. Group Operations Rooms also had gun liaison officers to provide Gun Operations Rooms with intelligence. At the bottom, Sector Operations Rooms would handle three squadrons to intercept the raids specified by group. Satellite airfields attached to each sector allowed aircraft dispersal where necessary.

Appendix B to Notes on the Air Defence of Great Britain gave average times for information processing. From the moment an RDF station detected an incoming raid from northeastern France, it took twenty seconds to plot on the Filter Room Table. Placing a directional arrow added five seconds. Plotting the transmitted data at the Operations Rooms would add thirty seconds, meaning that it had taken fifty-five seconds for the information to appear in visual form at the Operations Room. Observer Corps information took approximately one minute and forty-five seconds because of the need to pass information through the Observer Corps Intelligence Center first. A separate section within this report shows the times between the appearance of a plot on the Operations Table and fighter takeoff. If the aircraft were at “readiness,” it would be six-and-a-half minutes; otherwise, if only at “available,” this would be sixteen-and-a-half minutes.18

These figures were based on average times because of the limitations inherent in bases where runway congestion occurred because of two squadrons sharing the same facilities. Aircraft could not always stand at “readiness,” as rearming and refueling were time-consuming, especially when ground personnel became exhausted.19

The significance of this lay in the fact that German bomber formations needed only approximately twenty minutes to reach Croydon after crossing the coast, and if the targets were airfields south of London, then even this short time was

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17. “Notes on the Air Defence of Great Britain,” undated, TNA, ADM199/64.
18. “Notes on Air Defence of Great Britain—Appendix B,” TNA, ADM199/64.
reduced. RDF could not track aircraft over land, meaning that the only chance of monitoring an incoming raid lay with the ROC, but in conditions of poor visibility or low cloud, the ROC was powerless to help. Allen believed that a major problem contributing to interception delay lay within the functioning of the Filter Room. For him, the Filter Room “had some importance, but it is doubtful whether this exceeded its operational limitations. . . . The Filter Room, in fact, never functioned effectively in 1940.” The filtering process meant a significant built-in delay within the system. The indicator plaque showing the raid on the Operations Table might show the enemy aircraft twenty miles from its actual location if the raid was moving at 300 mph, meaning that the intercepting pilot was often vectored on the wrong position. Allen’s experience told him that the average pilot had difficulty spotting aircraft even at a distance of two miles, especially at high altitude where the pilot lacked a frame of reference. 20 Furthermore, as we shall see, the information from CH regarding height was often unreliable. However, a typical raid composed of bomb-laden Heinkel He.111s struggling against headwinds would have moved much more slowly than 300 mph, especially as heavier guns and more armor plate were progressively added, but even at 175 mph, an error of around thirteen miles was likely to have occurred. 21

Air Ministry files reveal that “filtering” proved a contentious issue and part of a dispute between Dowding and the assistant chief of Air Staff Sir Philip Joubert. The latter had been appointed to investigate the RDF chain for service control, no doubt because of Joubert’s interest in the command system and because of his responsibilities for Home Defence before the creation of Fighter Command. Limited Luftwaffe activity around the British Isles before January 1940 had led to allegations of missed interceptions stemming from organizational problems and overcentralization. These seem to have enraged Dowding to the extent that the Air Staff backed away from an all-out confrontation. As the acknowledged expert, Dowding was able to get away with making minor procedural adjustments to his

20. Ibid., 58.

21. Enzo Angelucci and Paolo Matricardi, World Aircraft: World War II (Maidenhead, U.K.: Sampson Low, 1978), 115, 117. Entries for the Dornier Do.17 and Heinkel He.111 bombers suggest that even without a bomb load, their typical speed would have been closer to 250 mph. Speeds would have been drastically reduced when fully loaded and flying into headwinds. Also see Derek Robinson, Invasion 1940: The Truth About the Battle of Britain and What Stopped Hitler (London: Constable, 2005), 192-3. Robinson advises that the weather charts for 15 September 1940 indicate that on this date, Luftwaffe formations contended with winds up to 90 mph. As a result, the bomber formation’s speed fell by half.
system. Dowding was beset with problems, but as Joubert explained to Churchill in an Air Ministry draft reply after the end of the heavy daylight-bombing phase, the Air Ministry “was unconvinced of the rightness of the C.in.C’s views.” They wanted experiments to loosen the rigidity and allow some decentralization. As the Luftwaffe had now begun intense night bombing, the problems of interception increased because the enemy was flying at higher altitudes than before and the darkness meant a great reduction in the distance that pilots could observe aircraft by unaided vision. This would have mattered less had RDF the capability to detect the precise position of the enemy formations. Consequently, “the question of decentralisation of filtering very naturally was reconsidered.” As Joubert saw it, the only reason that filtering needed to be done at Fighter Command HQ was because of the presence of liaison officers from other commands, but this applied only until Identification of Friend and Foe (IFF) devices became widely available in operational aircraft. Consequently, the Committee on Night Air Defence chaired by Sir John Salmond recommended, “the operation of filtering should be transferred from Fighter Command [HQ] to Group Headquarters in order to reduce delay.” With IFF devices soon to be made widely available, there was no reason why decentralization should not be made.

The Air Staff’s view was that the Luftwaffe would resume “intense operations” next spring with 2,000–2,500 aircraft aloft simultaneously and that this would result in “impossible congestion” if the relocation was not made soon. A further justification was that decentralization of filtering had already been carried out in the more far-flung Fighter Command Groups and had resulted in no “ill-effects” but in many advantages, including the “savings in the cost of land lines.” Decentralization would mean that the tracking of raids would be “told” simultaneously from groups to Fighter Command HQ and Sector Operations Rooms. Zimmerman mentioned that the draft reply was edited to delete a paragraph claiming that removing a step in this process saved between thirty seconds and several minutes depending on the scale of enemy activity because some members of the Air Staff considered this claim to be dubious.


24. W. S. Churchill to Sinclair, 27 October 1940, TNA, AIR19/476; Joubert to Assistant Private Secretary and Chief of Air Staff, 30 October 1940, TNA, AIR19/476; Draft of letter to Prime Minister, 9 November 1940, TNA, AIR19/476; Assistant Private Secretary to Deputy Chief
Dowding, unwilling to recognize the relevance of filtering to night air defense, thought it meant spending valuable resources constructing underground Filter Rooms. The “very small saving of time” would be outweighed by a delay in sending the information to Fighter Command HQ for the dissemination of air-raid warnings for civil defense. The balance of historical writing weighs against Dowding on this matter. However, the matter is not straightforward, because Dowding’s temperament was unsuited to making explanations to those lacking his intimate technical knowledge. He was partly right about the irrelevance of filtering to night air defense. It was not just a matter of giving British fighters enough time to gain altitude for interception because of the crucial need to position them at a more precise altitude for visual sighting of the enemy. Unfortunately, the majority of RDF stations were not properly calibrated for reading the altitude of aircraft in 1940. Significant problems also existed in assessing the direction of enemy raiders flying both by day and night. Dowding’s memorandum of 24 October 1940 told Churchill about the frequent use of directional checks known as “crosscuts.” In this example, RDF stations in the neighboring 12 Group would be used to “cross-check” the direction of raids traveling over 11 Group’s sea-area, but decentralization would remove this checking option. Another example suggested that if a raid was traveling along the boundary of 11 and 12 Group over the sea, it was possible that both groups would allocate raid numbers and fail to agree who should respond. The existing system, he claimed, ensured that there was no confusion as only Fighter Command HQ would allocate a raid number and decide which group should respond.

Poor calibration complicated the filtering process. As the official MOD Narrative stated, filterers often received wildly conflicting height estimates from two RDF stations picking up the same raid. As striking an average between the two readings was useless, the filterers had to work out which station was likely to have

of the Air Staff, 9 November 1940, TNA, AIR19/476; Private Secretary to Vice Chief of the Air Staff to Private Secretary of the Secretary of State, 10 November 1940, as quoted in Zimmermann, 210.

25. Dowding to the War Cabinet, 8 October 1940, TNA, AIR19/476.

26. TNA, AIR16/677, Dowding to Churchill, 24 October 1940. It seems plausible that the two RDF stations south of Norwich and within 12 Group’s boundaries were in a geographical position to track Luftwaffe raids proceeding towards the county of Suffolk or the Thames Estuary located within 11 Group. Fighter stations at Duxford and Castle Camps were located within a few miles each side of the Group land boundary, and this suggests some potential for confusion. Unfortunately, Dowding’s diagram which he originally enclosed to clarify his example at the TNA could not be located.
given the more accurate reading, presumably bearing in mind the experience of the operator and the geographical position of each station.27

Operational Requirements reports in June were said to have stated that, "interception over the sea usually failed because CH was not accurate enough, and CHL had no capability to measure height as it had originally been designed as a Coast Defence Set."28 E. C. Williams of the Stanmore Research Section (SRS), responsible for investigating the RDF chain's performance in 1940, provided notes indicating that most RDF stations could only calculate the elevation between one-and-a-half and six degrees owing to a lack of suitable equipment. While aircraft flying between 5,000 and 25,000 feet could still be detected, if the elevation was outside this band a wildly inaccurate height reading could be given, especially by an inexperienced operator.29

The notes of an Air Ministry meeting chaired by Joubert toward the end of the daylight battles provide further insight. The "requirements of calibration were stated on 3 April, before the full extent of expansion was under way." These were "ignored or disputed . . . and only now being taken seriously." Consequently, it was being considered that all the calibration problems stemmed from this "underlying cause." Those attending the meeting were also advised that crews for Radio Maintenance Units were inexperienced and that flight crews provided for test aircraft did not have the necessary training in blind flying because most had come straight out of flying schools. A high standard of training was required for all aircrew, particularly wireless telegraphy operators; the personnel provided lacked this. There were also complaints about the Blenheim aircraft used by Radio Maintenance Units, both in terms of numbers and poor serviceability. Both the limited resources and bad weather had made accurate calibration impossible throughout the winter; therefore, most stations were only partially calibrated during the fighting.30 A further problem connected with the accurate estimation of height and not mentioned in these notes related to the proximity of enemy air bases well within the maximum range of RDF. As Sir Robert Watson-Watt, scientific adviser on telecommunications, noted in his memoirs, it was "sometimes made more misleading by our very success, because first height reports might be


30. "Minutes of a Meeting Held at Air Ministry on 19 October 1940 to Discuss the Calibration of R.D.F Stations," TNA, AIR16/877.
made on formations which had not yet completed their climb to operational height.” His claim underlined the need for a second inland chain.  

The issue of the Radio Maintenance Unit’s Blenheim bombers was brought up as an illustration as to how Fighter Command’s interception problems were being aggravated by a lack of cooperation from others. In my opinion, this resulted from the Air Staff’s view of the use of resources for fighter defense as an unwelcome diversion of money away from Bomber Command. The Blenheim was an unsatisfactory aircraft by 1940 standards, but cast-off aircraft and inexperienced crews were all that Bomber Command would release for testing Fighter Command’s defense system. Better-trained crews and superior aircraft would have given Dowding’s system a more thorough prebattle testing than actually occurred. Sir Thomas Inskip, minister for Coordination of Defense, did successfully force a temporary change of priority from bomber to fighter production during the late 1930s. Nonetheless, the raison d’être of the RAF revolved around bombing theory, and the higher echelons of the Air Ministry were enthusiastic bomber advocates. Even as the Luftwaffe’s major assault was expected, the Air Council met to discuss increasing the output of pilots. Incredibly, given the crisis in Home Defense, the training of bomber pilots received the emphasis, with no reference to the fighter pilots or the grave situation currently facing Fighter Command.  

As will be seen, the RAF had been allocated a very large share of the national defense budget during the 1930s. In the milieu of competing resources, Bomber Command was used to obtaining the lion’s share. Unsurprisingly, then, Dowding failed to get the cooperation necessary for thoroughly testing his system before the Battle of Britain.

These problems were bad enough, but it was the areas of training and personnel where the prewar problems of rapid expansion hit hardest. Shortly after the war commenced, J. A. J. Tester, commanding officer at the RDF School, Bawdsey, sent the Air Ministry proposals for expanding the school. He painted a somber picture of the existing situation. “The operators at present leave the school with little or no idea of the following points, which are considered essential.” These were listed as “1) The R.F type of receiver, 2) The Anti-Jamming Devices, 3) Multiple Raids, 4) I.F.F, 5) Plotting and Filtering and 6) Counting.” This left the

RDF stations to finish off the training of operators. Tester complained that the school lacked a “complete dummy R.D.F system for training purposes” and enclosed a detailed shopping list of equipment. Mechanics training was also in a “lamentable state of affairs” down to the lack of training equipment. These limitations meant that trainees graduated with a good theoretical but a poor practical knowledge. This included “1) Any transmitter, 2) Any receiver, with the exception of the mobile one, 3) Any work culminating in the equipment going ‘on the air,’ 4) Phasing, 5) Stand-by power equipment, 6) G.M. [presumably General Maintenance].” All of this begs the question of what tasks the graduates could actually do. Tester probably exaggerated the school’s problems to obtain resources, but this was not the only indication of trouble.

As the day battles were about to enter an intense phase, E. C. Williams of the SRS at Fighter Command HQ commented on the declining standards of operators on the RDF chain. SRS continuously reviewed standards and found them “lower than it ever has been.” This was held directly attributable to shortening the Radio School course, sending “completely untrained personnel to the Chain,” and employing “totally unsuited personnel.” Williams was most concerned by personnel being trained by operators who were themselves only “half-trained” and remarked that the question of recruiting the wrong people had “probably never been tackled courageously.” He did not think the Radio School course should ever have been shortened to a fortnight, as even the original course had not been long enough. Training at RDF stations needed to be carried out under “live conditions” by competent individuals. He concluded by stating, “a large part of the efficiency of the R.D.F Chain is lost by poor operators, whose course of training has been curtailed.”

However, by December 1940, Sir Robert Watson-Watt was arguing for a massive expansion of the system. Given his central role as the government scientist who originally persuaded the government to develop RDF, he was now making effusive claims to justify what had been done. The “First Battle of Britain was won by R.D.F and the 8-gun fighter” and the value of the defense had been “multiplied by three to five times,” he stated. His memorandum to Sinclair stated, “that we have not yet proportioned our efforts in the installation of R.D.F coastal stations to the size and urgency of our programme.” He emphasized the “rudimentary state of the R.D.F cover in the West” and the “six months lateness in the East

34. J.A.J. Tester to Air Ministry, 9 October 1939, TNA, AVIA7/410.
35. Williams to Sigs.1, Air Ministry, 6 August 1940, TNA, AVIA7/410.
Coast programme” in support of his pleas for a larger and more powerful organization. Exploiting the prevalent assumption that the day battles would resume in the spring, Watson-Watt wanted the War Cabinet to start thinking on a grand scale and giving the “highest priority” for resources. He also needed a single engineering organization dealing with all aspects of RDF installation. Watson-Watt’s request was justified given the shortcomings resulting from the lack of priority given to resources; his exaggeration of the achievements was necessary in order to focus the attention of politicians.

In January 1941, Joubert reiterated the difficulties by summarizing the history of RDF personnel problems and the efforts of the Air Ministry’s Signals 4 in a memorandum. While it is unclear exactly whom he was writing this for, it was clearly connected with the further expansion recently advocated by Watson-Watt. Joubert described the recruitment of radio officers and radio mechanics/operators from January 1940 as “haphazard and mainly on a civilian basis.” Several appeals had been made, resulting in the recruitment of over 1,000 technicians, but the inadequacy of the training facilities resulted in embarrassment and opposition from the Ministry of Labour because too many men had already been taken from industry. Although it was still possible to recruit a limited number of radio mechanics, shortages of key personnel in other signals fields led to some being diverted elsewhere. Enough radio operators “up to the capacity of the training facilities” were finally obtained. By the end of June, it was realized that the sources of recruitment for radio officers and radio mechanics were nearly depleted, and an attempt to obtain 100 signals officers from Canada was instigated. Investigating the various options for placing a school out of bombing range caused delays, which meant that the additional school at Cranwell would not be operational until April 1941. Meanwhile, a “serious bottleneck” was likely if additional personnel were recruited because the existing facilities had insufficient capacity. Nevertheless, Signals 4 had obtained “200 Signals Officers (Radio) and over 2000 Radio Mechanics in the past 11 months.” It also claimed to have met Fighter Command’s demand for sixty filter officers, although this had proved very difficult, implying that quality standards had not been maintained. If the RDF system continued to expand, then overseas recruitment was necessary, but training facilities would still be inadequate. The arrival of Canadian radio officers and radio mechanics helped the system out of “serious difficulties,” but Joubert felt it was now necessary to reconsider the question of a Canadian school. Expansion plans

36. Watson-Watt to S. of S., Air Ministry, 21 December 1940, TNA, AIR20/2268.
could only be met if the training recruitment criteria could be relaxed, and he reluctantly recommended that the Radio Operators course should be reduced from four to three weeks.37

Despite the SRS's complaint of the previous August, shortening the Radio School course was again being proposed. Even so, Joubert had to take a broad view of the problem. A whiff of panic over the possibility of the Luftwaffe resuming the day battles during the spring was discernible. The significance of Joubert's summary written sometime after the day battles is that it placed the recruitment and training of personnel up to the end of the Battle of Britain in the context of an early phase of the long-term, grand-scale expansion needed for reasonable effectiveness.

As most of these documents suggest that considerable problems with the technical personnel badly affected the operation of the RDF chain, it seems likely that a high proportion of the German aircraft intercepted between July and October 1940 were detected by the unsophisticated methods of the ROC. This raises the question as to why such inflated claims have been made on behalf of RDF. The answers are easy to find.

These claims mainly stemmed from the need to encourage essential American logistical support. President Roosevelt was not an uncritical friend of Great Britain, and although Americans generally much preferred the British cause to the totalitarian one, assistance was neither spontaneous nor unconditional. Opinion polls published in American newspapers showed no majority support for direct intervention on behalf of Great Britain. At least there was significant support on the related question of helping Britain "even at risk of war," and the poll evidence showed that this increased during the Battle of Britain from 35 percent in May to 60 percent in November 1940.38 The sudden collapse of France had caused panic in Washington, as there seemed a real possibility of the British fleet falling into Axis hands. The question on American minds around the time of Dunkirk was whether the British were worth further support, or whether it might be better to keep the limited fruits of American war production exclusively for American defense. After all, Japanese imperial expansion presented an ongoing rival concern, and the bungled Norwegian campaign earlier in 1940 had not done anything to reassure the

37. Loose Minute Sheet from P. Joubert, 14 January 1941, TNA, AIR 8/5777.
38. George Gallup, "The Gallup Poll," The Washington Post 29.12 (1940): 11. Support for direct intervention, that is, an immediate war declaration, ranged from 5 percent in October 1939 to 19 percent in June 1940, falling to 17 percent in October 1940.
Americans over the British capacity to wage war. In order to carry on fighting, the British constantly had to reassure the Americans of their battle-worthiness.

The continued existence of a British fleet outnumbering the German Kriegsmarine at a ratio of over ten to one and the German plan to cross at night (negating the use of aircraft by either side) made the chance of a successful invasion of Britain extremely unlikely in 1940. Even so, British propaganda agencies worked on promoting the heroic image of the fighter pilot and the technological expertise of the RAF as the new bulwark against invasion.

To gain American confidence, a stream of technological gifts, many linked to the "successful air defense," was given away via the Tizard Mission. These included radar parts, aircraft engines, gun-turret technology, and machine tools for air-cannon, enabling the American rearmament program to proceed at a greatly reduced cost. Lord Max Beaverbrook, former minister of Aircraft Supply and confidante of Churchill, was especially critical of this policy, pointing out to the prime minister in December 1940 that the Americans had "conceded nothing" and made "negligible deliveries." Beaverbrook's wrath had been triggered by an American demand for British gold reserves, but he also mentioned that the machine tools for the manufacture of the Hispano cannon had already been taken to the United States, ostensibly to manufacture cannon for the RAF. Instead, he claimed, they kept the tools for their own use. An important gift was the cavity magnetron, a central technical component for the new radar system, due to enter service in 1942. U.S. scientists were very impressed, and the cavity magnetron revolutionized RDF technology by emitting more radio waves than other short wave valves. Advanced models had twice the power of anything else, but these only started production in August 1940, too late to influence the air campaigns of


40. Cumming, "Did the Navy Win the Battle of Britain?" 21–39. See also Robinson, 249. For information on the propaganda aspects, see Nicholas Cull, Selling War (Oxford: Oxford University Press, 1995), 90.

41. G. J. Piller, “Entry for Tizard, Sir Henry Thomas (1885–1959),” Oxford Dictionary of National Biography, 12 October 2007, cited at http://www.oxforddnb.com/view/article/36528?docPos=1. The Tizard Mission was a scientific mission from Britain to the USA and Canada. It was comprised of British civilians and military personnel led by government scientific officer Sir Henry Tizard (1885–1959). Their brief was to gain sympathy and support from the USA for the British cause. Military secrets were offered without conditions being imposed by the British.

42. Max Beaverbrook to the Prime Minister, 26 December 1940, London, Parliamentary Archives, Beaverbrook Papers, PA, BBK/D/414.

43. Zimmerman, 228.
the Battle of Britain. However, Americans did acknowledge the benefit of British technological assistance in the rearmament program that would later help the United States to save Europe.44

This was no time for the British to decry their technological achievements, and for Dowding, the perceived success of RDF was linked to his reputation, especially as his handling of Fighter Command during the course of the air battles had been controversial within the RAF itself. The circumstances of Dowding’s dismissal from Fighter Command at the end of the day battles have been much debated. He was clumsily treated over the timing of his repeatedly deferred retirement, but he was also stubborn, uncommunicative, and unsuited to working in teams. While the air battles were raging, Dowding spent much of his time immersed in the technical problems of night fighting—something that might reasonably have been delegated—leaving him open to charges of “hobby management.” No doubt, Ray came closest to the truth in suggesting that Churchill’s chairmanship of the Night Air Defence Committee had given him the chance to observe Dowding’s poor relationship with colleagues, implying that this was why Churchill ultimately failed to protect him.45 As Britain was now being bombèd at night with negligible loss to the Luftwaffe and Dowding was dismissive of interim solutions, it was not unreasonable to replace him. Had it not been for the need to paint the air defense of Great Britain in glowing colors for home and foreign consumption, his handling of the air campaigns would have been more harshly criticized. In need of some rehabilitation (at least in official eyes), Dowding befriended one of the leading historians of the day, Basil Liddell-Hart.

A letter from Liddell-Hart to a contemporary admired Dowding’s honesty, his empirical approach to scientific problems, and his “eagerness for new ideas.” Liddell-Hart even went so far as to wish that Dowding had been “in charge of our defence policy as a whole.”46 In a letter to Liddell-Hart, Dowding partly disassociated himself from the day-to-day handling of the air battles and hinted that he wanted to be remembered for his work in technical development before the war. “During the Battle of Britain I was personally more occupied with the

44. Anon, “Britain Will Not Lose War, US Air Corps Observer Asserts After Return,” The Washington Post 4.12 (1940): 1. This article featuring U.S. General Chany was geared toward boosting American confidence in British prospects and talked of “things that might be worth hundreds and millions of dollars to us.” He also mentioned “a large measure of [RAF] success . . . was attributed to the plane detection system employed.”


development of Night Fighting Defence than with the Day Battles," he wrote. "I had made my contribution to the former in the 4 previous years." Dowding was subsequently consulted for Liddell-Hart’s publications, including his influential History of the Second World War. Unfortunately, this distinguished writer may have blinded himself to both Dowding’s faults and the problems within the system that bore his name. Subsequent authors including Dowding’s aide, Robert Wright, have done the same.

The system might have been more effective had Dowding had intervened earlier in a damaging dispute between his two most important AOCs. Both Sir Keith Park and Trafford Leigh-Mallory were competent leaders of 11 and 12 Group, respectively, but a tactical disagreement during the height of the air fighting led to poor coordination and unnecessary damage upon the infrastructure of 11 Group, especially the crucial Sector Operations Rooms. The debate centered on Leigh-Mallory’s advocacy of using larger aircraft formations of three or more squadrons to inflict crippling losses on the Luftwaffe bombers. Unfortunately, these formations were rarely able to intercept before German aircraft bombed their targets. "Big-wing" proponents have usually blamed this on inadequate warning times.

Crucial Sector Operations Rooms were particularly vulnerable, being sited above ground—yet another example of the failure to obtain adequate resources. Six out of seven were damaged although quickly put back into service using Emergency Operations Rooms. However, these were an inferior substitute because they could not house all of the essential personnel and did not have enough General Post Office (GPO) landlines to "enable the normal operations of three squadrons per Sector," wrote Park.

49. L. Lucas, Flying Colours: The Epic Story of Douglas Bader (London: Hutchinson, 1981), 135–36, 157. In World War II, an RAF wing was a unit of three to five squadrons. Until the Dunkirk troop evacuation in 1940, an entire wing would rarely be airborne as a single formation. The use of single squadrons was the norm. Leigh-Mallory’s subordinate, RAF ace Douglas Bader, expanded the idea of using these “Big-wings” more widely after studying the World War I tactical concept of the “Flying Circus” or Jagdgeschwader. A reluctant compromise followed where units of two squadrons operated with varying degrees of success.
unscheduled groups of friendly aircraft could blot out the screens, thereby rendering them useless for their main job of detecting enemy aircraft. Leigh-Mallory was probably tactically wrong, but his experiment with these larger formations indicated that the centralized system of air defense in 1940 was not capable of dealing with sudden incursions of large numbers of friendly aircraft into the air space of a single group—a major handicap in the event of a German invasion. The Luftwaffe’s tactics of hitting 11 Group’s airfields and sector stations did win temporary air superiority (although not absolute supremacy) over the proposed invasion areas between 24 August and 6 September 1940.

In conclusion, these deficiencies should not detract from Dowding and his colleagues having built the nucleus of a formidable air defense system. However, on balance, it was not formidable in 1940, and he was wrong in placing such complete reliance on new technology. When the Germans resorted to night bombing, RDF was almost useless at protecting the civilian population from Luftwaffe attack. This overreliance forced Dowding into a defensive approach and led to allegations by some of his own officers—charges such as failing to ground-strafe the Luftwaffe’s new French airfields in the period immediately after Dunkirk. He has also been criticized for not attacking the slowly circling and unescorted bomber formations assembling over French promontories and for his “parsimonious” policy of fighter deployment when the full resources of Fighter Command could have been used to inflict crippling losses on the Luftwaffe. In other words, having devised a national defense network, Dowding unnecessarily threw the burden of defense onto 11 Group’s local resources.

If the RDF chain had received adequate resources during the late 1930s, there should have been enough properly trained operators and mechanics working at stations able to fulfill all functions. Had the Air Ministry “bomber barons” taken a broader view of the problems of air warfare, then Dowding might have secured the necessary cooperation to have his equipment thoroughly tested. Vast sums had been allocated to the RAF during the 1930s because of overblown but well-

51. Wright, 126. Wright argued that Dowding did request Bomber Command to attack French airfields but was refused. Allen, 135–38, argued that with over 700 fighters at his disposal, Dowding should have launched ground strafing attacks without Bomber Command’s assistance.

52. Lucas, 128–29, mentioned this strategy and compared it with Park’s tactics during the Battle for Malta when Axis bombers were engaged over the sea and sometimes over Sicily. Allen, 140–42, stated that the gaps in RDF and ROC intelligence were often filled with information from the aircraft of No. 421 Flight that regularly reconnoitred French promontories to monitor assembling bombers. More frequent patrols with other squadrons would have provided opportunities for attacking the bombers while they were still unescorted and heavily loaded.
publicized theories of airpower. A memorandum by the chancellor of the Exchequer in 1937 rightly criticized the Air Ministry’s plans for expansion:

If that scheme is approved without reservation the Air Ministry will need to expend in the five years to 1942 a sum which exceeds by nearly £350 millions the amount which could be allotted to it out of the total five years expenditure of £1,650 millions for all Defence Services (including Civil Defence). . . .

The RAF had their fair share of money by 1940, but the RDF chain had been forced to compete with a resource-hungry bomber force, and many British civilians paid for this with their lives. “Radar was still in its infancy,” wrote Churchill in 1949, “but it gave warnings of raids approaching our coast, and the observers with field glasses and portable telephones, were our main source of information about raiders flying overland.” Watson-Watt’s memoirs ridiculed the former prime minister for saying this, but Churchill’s remarks seem an accurate assessment of the RDF system of 1940.

53. “Appendix. Air Ministry Programme. CP.218(38),” Minute by the Chancellor of the Exchequer, TNA CAB 27/648.
55. Watson-Watt, 250.