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AIR OPERATIONS BY FIGHTER COMMAND FROM 25th NOVEMBER 1940 TO 31st DECEMBER 1941

The following report was submitted to the Secretary of State for Air on 29th February, 1948, by Marshal of the Royal Air Force Sir Sholto Douglas, G.C.B., M.C., D.F.C. (now Lord Douglas of Kirtleside), former Air Officer Commanding-in-Chief, Fighter Command, Royal Air Force

PART I: OPERATIONS.

Night Operations.

(a) The Situation on 1st November, 1940

1. At the beginning of November, 1940, the most urgent problem confronting the air defences was that presented by the night bomber. For the first ten months of the war the Luftwaffe had undertaken only minor operations against this country; but in June, 1940, the enemy began a series of small-scale night attacks on ports and industrial towns. During the next two months, while the daylight battle of Britain was being fought, this night offensive gathered momentum. On September 7th London became its main objective, and the scale of attack increased once more. By the end of October the night offensive had become in many respects a bigger threat to the kingdom than the day offensive, which, for the moment at least, had been successfully beaten off.

2. At that stage London had been raided on every night but one for the last eight weeks. On every night but four during those eight weeks at least a hundred tons of bombs had fallen on or around the Capital; Coventry, Birmingham and Liverpool had all suffered attacks of some weight. So far no intolerable harm had been done to industry or the public temper, although many people had been killed and much material loss and hardship had been caused. But there was every reason to expect that the attacks would continue and perhaps grow heavier; for during the last two months the defences had claimed the destruction of only 79 night bombers—a number

equivalent to about a half of one per cent. of the number of night sorties that the Germans were believed to have flown in that time. Obviously, losses of this order were not likely to act as a deterrent.

3. The directive by which I found myself bound when I assumed command on 25th November, 1940, required me to give priority to the defence of the aircraft industry. No formal variation of this directive was needed to make it clear that the defeat of the night bomber must be one of my main tasks.

4. It would be wrong to give the impression that hitherto this problem had been ignored. On the contrary, it had long been foreseen that if the enemy found day attacks too expensive, he would probably turn to night bombing on a substantial scale. But with limited resources it had been necessary to place the emphasis on high-performance, single-seater fighters capable of defeating the enemy by day. Before the war, and in the early stages of the war it was hoped that, with the help of searchlights, these aircraft would also be effective at night.

5. This hope had proved vain. Except at the beginning of the night offensive, when the enemy flew at 12,000 feet or lower, the searchlights were incapable of doing what was required of them. This was partly because they relied on sound locators, which were unsuited to modern conditions, and partly because very often cloud or moonlight prevented pilots from seeing the searchlight beams at the height at which they had to fly.

6. A method of night interception which did not rely on searchlights had been under development (although not continuously) since 1936. This method rested upon the installation in twin-engined, multi-seater aircraft of the radar equipment known as A I.

7. On November 1st, 1940, the Command had possessed six squadrons of aircraft fitted with this equipment. All were Blenheim Squadrons,

but as the Blenheim was too slow and too lightly armed to take full advantage of its opportunities, Beaufighters were being substituted for the Benheims as fast as the Air Ministry and the Ministry of Aircraft Production could make them available.

8. But at best the provision of A.I. solved only half the problem. This airborne Radar had a restricted range which could not be greater than the height of the aircraft, subject to a maximum of $3\frac{1}{2}$ miles. Before the A.I. could detect an enemy bomber in the darkness, the fighter had therefore to be brought to within three miles of it at roughly the same height. If searchlights were ruled out, this could only be done by means of directions given to the pilot by a Controller on the ground. It was vital that this controller should have accurate knowledge of the bomber's position. Under my Command, I had No. 60 (Signals) Group, which controlled a chain of some 80 Radar Stations round the coasts, used for giving early warning to the controller of the approach of enemy aircraft across the sea. Over land, information on the raider's position was given by the Observer Corps. Although these sources had proved sufficiently accurate for daylight interceptions, they were not precise enough for successful night fighter operations.

9. Only Radar could provide the answer—special ground search radar stations for the direct control of A.I.-equipped night fighter aircraft. Such stations, termed G.C.I. (Ground Control of Interception), were under development when I assumed Command. Nevertheless, the tactics of their employment in conjunction with A.I. night fighters had yet to be evolved from practical experience as and when the G.C.I. stations became available.

10. The Radar Stations used for detecting the approach of enemy aircraft across the sea had only a limited application to this problem, but another kind of ground radar equipment, designed for gun-laying and known as G.L., promised to give good results. Although other varieties of radar equipment were under development, the defects of both ground and airborne search radars were not the most important factors in the establishment of an efficient night fighter defence. Any success A.I. was likely to achieve depended initially on the skill of the ground controller and then on the operational ability of the aircraft A.I. observer. There was an acute shortage of personnel for both of these highly specialised tasks.

11. It was clear that many problems of method, maintenance and supply would have to be solved before all this delicate equipment could be expected to yield concrete results, and that their solution was likely to take some months. In the meantime, the Air Ministry were anxious that some immediate attempt should be made to improve the situation.

12. A step in this direction had already been taken in the late Summer, when it was decided that the two Defiant Squadrons in the Command, together with a third Defiant Squadron which was about to be formed, should be turned over from day to night duty. Despite its early successes as a day fighter, the Defiant had proved too slow and too vulnerable to attack from below to be effective against the Me 262, but it was still likely to prove a useful weapon against bombers.

13. In addition, three Hurricane Squadrons had been turned over to night duty, in the middle of October, 1940.

14. Thus when I assumed Command, the night-fighter force comprised the following squadrons:—

Squadron	Equipment	Station
No. 23	Blenheim ...	Ford
No. 25	Blenheim and Beaufighter.	Debden
No. 29	Blenheim ...	Digby and Wittering.
No. 219	Blenheim and Beaufighter.	Redhill
No. 600	Blenheim ...	Catterick and Drem
No. 604	Blenheim ...	Middle Wallop
No. 141	Defiant ...	Gatwick
No. 264	Defiant ...	Rochford
No. 73	Hurricane ...	Castle Camps
No. 85	Hurricane ...	Kirtón-in-Lindsey
No. 151	Hurricane ...	Digby

15. In addition to these first-line units, the Fighter Interception Unit at Tangmere had the task of developing methods of night interception with twin-engined fighters; and sometimes provided aircraft for active operations, No. 422 Flight had been formed recently at Gravesend to study the problem of night interception with single-engined fighters; while a new Defiant Squadron, No. 307 (Polish) Squadron, was forming at Kirton-in-Lindsey, No. 420 Flight (later No. 93 Squadron) had just begun to form for the purpose of sowing and trailing mines in front of German bombers. Finally, the formation of No. 54 Operational Training Unit, to specialize in night training, had been ordered.

16. I also had operational control of the guns and searchlights of Anti-Aircraft Command, under Lt.-General Sir Frederick A. Pile, Bart., K.C.B., D.S.O., M.C., and the balloon barrages of Balloon Command under Air Vice-Marshal O. T. Boyd, C.B., O.B.E., M.C., A.F.C. (succeeded on 1st December, 1940, by Air Marshal Sir E. L. Gossage, K.C.B., C.V.O., D.S.O., M.C.).

17. In the early stages of the attack, except in conditions of good visibility, the A.A. guns had to rely on one of three methods of directing their fire. These were: illumination of the bomber by searchlights, which were controlled by sound locators; a combination of rather rudimentary radar and sound locator, or a system of prediction which depended entirely on sound locators. The shortcomings of these sound locators were a great handicap to A.A. gunnery, and the gunners deserve great credit for their achievements at a time when night fighters were almost powerless. By 25th November, 1940, radar equipment for gun-laying was beginning to arrive, and a variant intended for controlling searchlights (S.L.C. or "Elsie") was on the way.

18. Other means of frustrating enemy bombers included measures designed to jam or otherwise interfere with the directional beams that they used to find their targets, and various kinds of dummies and decoys which were intended to attract bombs. With the exception of decoy and dummy airfields, these were not under my control, but liaison was maintained with those responsible for their operation.

(b) *Operations, November and December, 1940.*

19. During the first two weeks in November, London had continued to be the enemy's main target, and was visited by at least 100 German bombers nearly every night. Then, in the middle of the month, came a change. On the night of 14th November, by the light of the full moon, nearly 500 German aircraft delivered an attack on Coventry which lasted from about eight o'clock in the evening until half-past five the following morning. The attack began with the dropping of large numbers of incendiary bombs by a Unit called K.Gr.100, which was known to specialize in this form of target marking. More incendiaries, hundreds of high explosive bombs and a number of parachute-mines followed. The raid wrought great havoc in the centre of the city, severely damaged 21 important factories, wrecked gas and water-mains and cables, blocked the railways, and put four or five hundred retail shops out of action. Three hundred and eighty people were killed and 800 seriously injured. The Civil Defence Services did excellent work, and, though shaken, the citizens of Coventry remained undaunted.

20. The defences were not unprepared for this move. The A.A. guns put up a tremendous volume of fire, and 123 fighter sorties were flown, day squadrons as well as night squadrons taking part. A few enemy aircraft were seen and some of them were engaged, but none of these combats was conclusive. The A.A. gunners claimed the destruction of two bombers.

21. Another such raid on Coventry soon afterwards might have created a serious situation. Fortunately the Germans did not consider a second raid necessary, and on the next night London was once again their main objective. But, for the rest of the month and throughout December, provincial towns and cities, including Southampton, Bristol, Plymouth, Birmingham, Sheffield, Liverpool and Manchester, competed with London for their attention. Clearly they had passed to a new stage in their programme and were now seeking to dislocate our means of production and supply.

22. Although this phase of the offensive did not come as a surprise, the ability of the Germans to reach and find their targets in wintry conditions was disturbing. With the help of radio beacons, directional beam systems, and blind-landing devices, the bombers were able to operate effectively in weather which seriously hampered and sometimes precluded fighter operations. As yet the new methods of interception which depended on radar were not perfected, and the less elaborate methods which we had hoped would tide us over this intervening period were largely defeated by this factor of bad weather. Inasmuch, however, as the enemy bomber crews were mainly reliant upon radio beams and beacons for navigation and bomb aiming in conditions of bad visibility, they were correspondingly vulnerable to radio counter-measures against those aids. There had grown up since the beginning of the war an extensive organisation which had developed a most effective technique for interfering so subtly with radio beams and beacons as to leave the enemy almost unaware of the fact that his own aids were leading him astray.

This organisation had been consolidated shortly before I assumed command, in the form of No. 80 Wing, whose invaluable services were almost entirely at my disposal. Operating in association with other forms of decoy, No. 80 Wing was responsible for deflection of a great number of enemy bombers from their targets, while the information it gathered as to the orientation of enemy radio beams from time to time proved a valuable guide to the air defences as to the enemy's intentions. Indeed, until our night fighters were to become a weapon of any significance against the enemy bombers in March of the following year, radio counter-measures were to contribute as much as any other defensive arm towards reduction of the impact of the enemy bomber offensive.

23. On the night of 19th November, a pilot and crew of No. 604 Squadron, using their A.I. in conjunction with searchlight indications and instructions from their Sector Controller, had succeeded in engaging a large aircraft over Oxfordshire. The crew of a Ju88 which crashed later in Norfolk reported that they had been attacked by a fighter on their way from the South Coast to Birmingham; and it seems probable that this was the aircraft engaged over Oxfordshire. If so, this was the first enemy aircraft whose destruction was attributable to a fighter carrying A.I. and belonging to a first-line squadron, although as long ago as July a success in active operations had been claimed by the Fighter Interception Unit.

24. Up to the end of the year fighters claimed the destruction of only three more night bombers, and none of these successes was attributable to A.I.

25. Many novel and unusual means of dealing with the night bomber were suggested about this time and subsequently. The more practicable of these included the release of a free balloon barrage, other forms of aerial mining, and the use of searchlights carried by aircraft. These are dealt with below under the appropriate headings.

26. On a number of occasions I arranged for fighters carrying equipment which responded to the "beam" transmissions which the Germans used to find their targets to be sent to "hunt in the beam," but the German crews seem to have anticipated this move and were wary. Fighters sent to patrol the points at which the bombers were expected to cross the French coast on their homeward journey, burning their navigation lights, were no more successful.

27. On the night of 11th December, I tried out for the second time, a measure which had previously been given an inconclusive trial over Bristol. Twenty Hampden bombers were sent to patrol at various specified heights over Birmingham during a concentrated attack on that city. The crews reported seeing a large number of enemy aircraft, but the Hampdens were too unwieldy to bring any of them to action. This experience proved, however, that in suitable circumstances interception by purely visual means was possible.

28. Meanwhile we were taking every possible step to improve the chances of interception by more orthodox means. Up to this time such G.L. sets as were available to assist the fighters had been grouped close together in the Kenley Sector. In consultation with General

Pile, I now arranged for them to be more widely spaced to form a "G.L. Carpet," designed to extend over the whole of Southern England from Kent to Bristol and ultimately, we hoped, over a still wider area. I also arranged with General Pile that the searchlights should be grouped in clusters of three, instead of singly, in order to provide a stronger illumination. In addition, I earmarked a number of airfields as night-fighter bases and took steps to equip them with every available aid to night flying.

29. It became clear in December that for the adequate defence of the Kingdom more specialist night squadrons were needed, and I therefore asked the Air Ministry to provide, as soon as possible, a total of 20 such squadrons, to include twelve twin-engined squadrons. Although it was some time before this figure was achieved, substantial additions were made to the night-fighter force during the ensuing months.

30. In the second week of December I was informed that the Air Ministry wished me ultimately to accept responsibility for the "Security Patrols" which had hitherto been flown by aircraft of No. 2 Group, Bomber Command, over airfields in Northern France and the Low Countries.

31. The use of fighters for this work had already been discussed by my Staff with No. 2 Group, and arrangements were being made for aircraft of No. 23 Squadron to supplement the efforts of No. 2 Group's Blenheims. On receipt of the Air Ministry's letter, I ordered that the whole of No. 23 Squadron should be turned over to this duty, to which the name "Intruder" was now applied. The A.I., whose capture could not be risked, was removed from the squadron's aircraft, navigators were posted to the squadron, and some crews were sent to one of No. 2 Group's Stations to learn all that they could about the operation. The squadron was ready to operate by 18th December and the first patrols were flown on the 21st.

32. A further account of operation "Intruder" is given below, under a separate heading. (Paras. 68 to 72.)

33. On 29th December, the Capital suffered one of its worse raids of the war when a determined attempt was made to destroy the cities of London and Westminster by the dropping of large numbers of incendiary bombs. Nearly 1,500 separate fires were started, some of them of vast dimensions. The weather was poor and the night-fighter force had no success.

(c) Operations, January to May, 1941.

34. Early in the New Year the efforts made to apply the principles of Radar to the special problems of night defence began to yield results. Radar equipment began to be available in increasing quantities, although it was some time before the S.L.C. sets needed by the searchlights arrived in anything like sufficient numbers. The performance of the heavy A.A. guns at night, measured by the number of rounds required to bring down one enemy aircraft, quickly improved and soon surpassed the standard achieved in daylight at the end of the 1914-1918 war.

35. For the fighter force an important step forward was the arrival of G.C.I. sets—hitherto

only in the development stage—which enabled a ground controller to follow on a fluorescent screen the track in the horizontal plane both of a selected bomber and of the fighter sent to intercept it.

36. At first these sets could not read height with any accuracy, but their performance in this respect was soon improved.

37. For some time progress was slow, but by March substantial results were being achieved by the night-fighters, and indeed in that month their claims exceeded those of the A.A. gunners for the first time since June, 1940. Of the 43 night bombers whose destruction was claimed that month, 22 were claimed by the night-fighter forces, and half of these by twin-engined fighters using their A.I.

38. From this moment the A.I. fighter became the principal weapon of the night-fighter force. Unlike the single-engined fighter, it was not dependent on moonlight or artificial illumination and could therefore be used in weather which put the single-engined fighter out of court. From March onwards the steadiest results were claimed by A.I. fighters. On the other hand, a number of clear moonlit nights in Spring, on which German aircraft were to be found in large numbers over their target and along the route thereto, gave the single-engined fighters opportunities which enabled them to surpass, for short periods, the performance of their twin-engined rivals.

39. From that moment, too, the fighter rather than the A.A. gun became the chief means of inflicting casualties on the night bomber. But it would be unwise to draw any hasty conclusion from this fact. Although there was always a friendly rivalry between guns and fighters, it was recognised throughout the war that together—and in conjunction with the balloon defences—they formed a team of which all the members were indispensable. The value of what may conveniently be called the static defences was not to be measured solely, or even mainly, by the casualties which they inflicted on the enemy. Their deterrent effect, not only in causing some bombers to turn away before reaching their target, but in preventing leisurely and methodical bombing from low altitudes by the remainder, was always of inestimable value. The experience of the "Baedeker" raids (which came after the end of the period now under review) proves that if important objectives had been deprived in 1941 of their gun and balloon defences, they could very quickly have been destroyed, regardless of any action by night-fighters. Moreover, it must be remembered that the limitations of Radar at this time made interception at low altitudes extremely difficult. If the guns had not helped to keep the enemy up, successful interceptions at night would have been rare.

40. On the other hand, the guns and balloons were equally incapable of acting as a complete defence in themselves, but required the co-operation of the more mobile fighter, which was capable of harrying the bomber wherever he flew.

41. In January and February bad weather frequently defeated all the enemy's attempts to make his bombers independent of extraneous circumstances, by rendering many airfields un-serviceable. Chiefly on this account, the German effort declined considerably. March

brought a revival, and in April and May the Germans increased their scale of attack still further in an attempt to conceal their intentions with respect to Russia.

42. Early in 1941, the Germans began to show an increasing tendency to concentrate on ports and shipping. There were other signs that an attempt to strangle our sea communications was contemplated, and at the end of February, I was instructed by the Air Ministry to provide additional "watch and ward" for coastwise shipping, and warned that the German bomber force might be expected to pay special attention in future to ports on the West Coast.

43. Early in March this was followed by a formal directive which required me to give priority to the defence of the Clyde, the Mersey and the Bristol Channel, which were now to rank above the aircraft industry in this respect.

44. I immediately took steps to strengthen the A.A. defences of these areas, partly by moving guns from other parts of the country and partly by pledging a substantial part of the anticipated production in March and April. By the middle of March, the move of 81 additional heavy A.A. guns to the West Coast ports had been ordered, and shortly afterwards further increases amounting to another 104 heavy A.A. guns were arranged. Actual increases exceeded what had been planned: 58 guns were withdrawn from the Midlands in March, and 24 guns came from the factories: by 1st June a further 106 new guns had been deployed.

45. I also modified the deployment of the night-fighter force in order to give increased protection to the Clyde and the Mersey. I considered that the Bristol Channel was already adequately defended by the squadrons deployed to cover the Southern approaches to the Midlands.

46. In spite of the enemy's growing tendency to attack ports and shipping, his attention at this stage was by no means exclusively devoted to such objectives. Many attacks were made on London and provincial towns, and the operations of German long-range fighters against our bombers and their bases caused some concern.

47. On the night of 10th May the enemy made the most ambitious attack on London that he had attempted up to that time, or indeed was ever to attempt. Although contemporary estimates were lower, it is now known that the German bomber force flew more than 500 sorties on this night. Visibility was good and the results were eminently satisfactory. A total of 60 single-engined fighters were sent to patrol at various heights over London, twenty over Beachy Head, and smaller numbers over the other approaches to the Capital, while twin-engined fighters were used to intercept the bombers as they came and went. These defensive fighters claimed between them the destruction of 23 enemy aircraft, of which the single-engined fighters claimed nineteen. A Defiant on an "Intruder" patrol over Northern France claimed one more, making 24. The A.A. gunners, although their fire was restricted by the presence of our fighters, claimed another four, making a grand total of 28 enemy aircraft, or roughly five per cent. of the enemy effort.

48. Perhaps the most remarkable feature of this night's operations was the success of the Hurricane and Spitfire flying in the Bomber Stream. On various other nights in April and May, aircraft on "Fighter Night" patrols claimed the destruction of twenty enemy aircraft in the aggregate. The impression that "Fighter Nights" was an unprofitable operation is widespread, but these figures show that, given good weather, moonlight, and a substantial concentration of enemy aircraft, these patrols could achieve satisfactory results. It was, however, only at periods when the moon was above the horizon that any success was achieved.

49. Operation "Fighter Night" was, of course, always regarded with disfavour by the A.A. gunners, whose chances of success it diminished. When it was first put into effect, the guns in the target area were forbidden to fire; but it was argued that their silence might cause apprehension amongst the public, and later they were allowed to fire up to heights safely below that of the lowest fighters. Such a restriction of A.A. fire was only justified, of course, when the conditions were particularly favourable to fighters, but the figures just quoted show that in these conditions its justification was beyond dispute. It is interesting to note that, despite the limitation imposed on them, the guns in the target area were not always barren of success on these occasions. While generally the guns kept the German bombers up to the heights at which the fighters could most conveniently engage them, it would seem that on occasions the fighters must have forced individual bombers down into the A.A. belt.

50. A night of scattered raiding on 11th May brought to an end the intensive phase which had begun eight months before. Thereafter, until the end of the year, the scale of attack was much smaller. Although a few more raids were made on London and the Midlands, the Germans devoted most of their attention for the rest of the year to targets near the coast or at sea, and to minelaying.

51. Undoubtedly the main reason for this change was a new strategic conception by the Germans. Having decided to attack the Russians, they withdrew most of their bombers from the West, leaving behind only a small force to second the German Navy's attempt to blockade the British Isles. To what extent this decision was due to the realisation by the enemy that his night offensive was failing as surely (though not so spectacularly) as his day offensive had failed in the previous Autumn, I do not know. But that the "Blitz" did fail to achieve any strategic purpose is clear enough. In eight months of intensive night raiding, the German bomber force did not succeed in breaking the spirit of the British people or preventing the expansion of our means of production and supply. Moreover, the cumulative effect of the ever-increasing losses which the Germans incurred as the defences got under way cannot have been a negligible factor, even though these losses were not sufficient in themselves to have brought the offensive to a standstill. To the country as a whole, and everyone in it, the end of the night battle was a great relief; nevertheless there was a sense in which it came to those under my command, and indeed to myself, as something of a disappointment. An

enemy over whom we felt that we were gaining the mastery had slipped out of our grasp. All arms of the defence were working better than they had ever done before; the first five months of 1941 had seen a steady and striking improvement in the results achieved. We were confident—I am confident still—that if the enemy had not chosen that moment to pull out, we should soon have been inflicting such casualties on his night bombers that the continuance of his night offensive on a similar scale would have been impossible.

(d) *Operations, June to December, 1941.*

52. As it was, the minor operations which formed the staple of the German night offensive during the second half of 1941 gave few chances to the defences. Minelaying aircraft, which flew low and could usually avoid gun-defended areas, were particularly hard to shoot down, and although we made many attempts to evolve means of intercepting them, it was not until 1942 that we had much success. But when the enemy did venture overland, the improvement which had been made since the beginning of the year was well maintained. When the Medway towns were attacked in June, for example, the defences claimed the destruction of seven enemy aircraft out of less than 100 operating; on two successive moonlit nights in July, eleven out of about 170 were claimed; and on the first night of November, when some 50 aircraft operated against Merseyside, the defences claimed the destruction of six.

(e) *The Free Balloon Barrage.*

53. Towards the end of 1940, I made arrangements to release balloons carrying lethal charges in the path of German bombers approaching London. The intention was to use this free barrage on nights when the conditions were unsuitable for fighters; but it did not follow that whenever conditions were unsuitable for fighters they would be favourable for the Balloon Barrage, which had certain positive requirements of its own. These were by no means easy to satisfy. A disadvantage of the scheme was that deployment of the equipment had to be begun many hours in advance, on the strength of a difficult meteorological forecast, and on the chance that when the time came the character of the enemy's operations as well as the weather would favour release.

54. The first release was made on the night of 27th December. Imperfect communications caused a delay of 35 minutes between the issue of the order to release and the ascent of the first balloons. Shortly afterwards the enemy attack died away and the order to stop releasing the balloons was given. So far as is known the comparatively small number of balloons released had no effect on the enemy.

55. A further release on the night of 11th January, 1941, went much more smoothly. The weather turned out as predicted and 1,252 balloons were released over a period of three hours. Some 60 German bombers flew through the area in which the barrage was operating but appeared to be quite unaffected by it, mainly, perhaps, because the balloons were too widely spaced to give a good chance of success.

56. Although arrangements were subsequently made to improve the equipment and system of release, the scheme never achieved any practical success and was eventually abandoned.

(f) *No. 93 Squadron.*

57. No. 93 Squadron was formed in the late Autumn of 1940 for the purpose of trailing and sowing aerial mines in the path of German bombers. During its life of rather less than a year the squadron claimed a number of successes, and the destruction of two enemy aircraft—one in December, 1940, and one in the following April—was officially credited to it.

58. As time went on, however, the performance of orthodox night-fighter squadrons using A.I. improved so much that I came to the conclusion that the comparatively modest results achieved by No. 93 Squadron did not justify the manpower and effort involved in its continued existence. In November, 1941, therefore, I obtained authority to disband the squadron.

(g) *Airborne Searchlights.*

59. The idea of a searchlight carried in an aircraft is an old one, but the practical difficulties involved are considerable, because of the great weight of the equipment needed to produce a sufficiently powerful light.

60. In 1941 this problem seemed to have been solved, thanks to the skill and ingenuity of Air Commodore W. Helmore. Aircraft carrying searchlights were now a practicable weapon and I was ordered to form the equivalent of five squadrons of Havoc aircraft so equipped.

61. In trials these aircraft succeeded in illuminating and holding their targets while attendant single-engined fighters intercepted them. The crews of the target aircraft reported that the effect when the Havoc suddenly switched on its searchlights and held them in its blinding glare was extremely disconcerting, and hopes ran high.

62. By the time that the Havocs were ready for active operations, however, the enemy effort had dwindled to very small proportions, so that the scheme had no chance to prove its worth in 1941. When, after the end of the period now under review, the Havocs were given their opportunity, they proved too slow to compete on level terms with the orthodox A.I. squadrons against the faster bombers with which the German bomber force was then equipped.

(h) *Deployment of Ground Searchlights.*

63. Reference has been made to the siting of the searchlights in clusters of three during the winter of 1940-41.

64. This arrangement was found to be no solution to the problem, and, in the autumn of 1941, I arranged with General Pile for the searchlights to be re-sited singly.

65. Their primary function was now to help fighters to intercept, since the heavy A.A. guns were no longer dependent on them, and the basis of the new system was what was called the "fighter box."

66. It was found by calculation and experiment that the area within which a fighter pilot could hope to pick up and intercept a bomber with the aid of searchlights alone was a rectangle 44 miles long and 14 miles wide. Accordingly, we divided the whole of the area to be covered by searchlights into rectangles of this size. The searchlights were then so arranged that in the centre of each rectangle

there was a stationary vertical beam. Round this beam the fighter circled until an enemy bomber entered the "box." Other searchlights were disposed at intervals of $3\frac{1}{2}$ miles near the centre of the box and wider intervals near its borders. As soon as the bomber entered the box the beams of the outlying searchlights (belonging to the "Indicator Zone") began to converge on it, thus indicating its approach to the fighter pilot, who thereupon set a course which would put him in a position to intercept it in the central "Killer Zone."

67. This system was not working with full efficiency by the end of 1941, but ultimately proved very effective and remained substantially unchanged until the end of the war.

(j) Operation "Intruder".

68. The circumstances in which No 23 Squadron began to fly "Intruder" patrols on 21st December, 1940, have been described above.

69. It was not until the early spring that the squadron had many opportunities of successful action. With better weather and increased enemy activity it was then very successful, claiming the destruction of three enemy aircraft in March, 1941, two in April, and eleven in May. Thereafter, opportunities were again limited. Nevertheless, it was decided that a second "Intruder" Squadron should be added to the Command, and No. 418 (R.C.A.F.) Squadron, equipped with Bostons, began to form in the autumn.

70. No. 23 Squadron, originally equipped with Blenheims, re-armed with Havocs in March and April, 1941, and received a few Bostons later in the year.

71. Between 21st December, 1940, and 31st December, 1941, operation "Intruder" was carried out on 145 nights and 573 sorties were flown, of which 505 were by Blenheims, Havocs and Bostons of No. 23 Squadron, and 68 by Hurricanes and Defiants of Nos. 1, 3, 87, 141, 151, 242, 264, 306 and 601 Squadrons, which were employed on this work occasionally on moonlit nights. The destruction of 21 enemy aircraft was claimed, 290 separate bombing attacks on airfields were reported, and ten of our aircraft were lost.

72. Throughout this period the executive control of this operation was something of a problem. To secure the best results, it was essential that the "Intruder" aircraft should arrive at active enemy bases just as returning bombers reached them. This could only be achieved by a close study of information from intelligence and raid-reporting sources on the part of those responsible for ordering the despatch of the "Intruder" aircraft. In accordance with the normal practice in my Command, control of the operation was delegated at the outset to No. 11 Group, from whose stations No. 23 Squadron was operating. The executive orders were issued by whichever of the Controllers at No. 11 Group's Headquarters happened to be on duty at the time, in consultation with the Officer Commanding No. 23 Squadron. It was a matter for consideration whether these Duty Controllers, with their numerous responsibilities, could be expected to give that constant specialized attention to the changing data provided by the

Intelligence and Raid-Reporting services which was essential for success. The suggestion that control of the operation should be exercised directly from my Headquarters was made more than once and from more than one quarter in 1941. I did not think it desirable to make any change at this stage, but later, when the necessity of co-ordinating the work of the "Intruder" Squadrons closely with the operations of Bomber Command made a more centralised control almost essential, this solution was adopted.

Day Operations

(a) Defensive

(i) Forces Available.

73. At the end of the Battle of Britain, that is to say at the beginning of November, 1940, the strength of the day fighter force amounted to $55\frac{1}{2}$ squadrons, including three and a half squadrons in the process of formation. On paper this was a substantially larger force than the Command had possessed at the beginning of the battle; but really the force available was weaker. Many of our best pilots had been killed, and quantitatively the casualties had proved greater than the training organisation could make good, so that despite such expedients as the transfer of pilots from other Commands, the squadrons were short of their proper establishment of pilots.

74. The long-term measures taken within the Command to ameliorate this situation are described in Part II. In the meantime the position was such as to give some ground for anxiety. Of the 52 operational day squadrons in the Command at the beginning of November, only 26 were, in the most strict sense, first-line squadrons. Another two squadrons were being kept up to operational strength so that they could act as reliefs in an emergency. The remainder, apart from a half-squadron employed as "spotters," had only a few operational pilots apiece and were suitable only for employment in quiet sectors.

75. The practice of stripping some squadrons of most of their experienced pilots in order to keep others up to strength is clearly indefensible except in a grave emergency, if only because of the invidious distinctions thus created. It had been adopted by my predecessor in the late Summer only because, in the circumstances of that time, it seemed the sole alternative to "telescoping" or disbanding squadrons. As soon as conditions permitted, I abandoned this system, with its categorisation of squadrons as class "A," "B" or "C," and all squadrons in turn were given their chance in the more active Sectors.

76. Although the Battle of Britain is now regarded as having ended on 31st October, 1940, no sharp break was noticeable at the time. Not until some weeks later was it evident that, for the time being, the Germans had abandoned the idea of defeating the Command by a series of mass attacks in daylight. Even then a resumption of these mass attacks in the following Spring or Summer was regarded as inevitable; and in December I asked for a force of 80 day fighter squadrons to meet this situation.

77. The Air Ministry were unable to accept the dislocation of their plan for the expansion of other Commands which the attainment of

so large a fighter force by the Spring or early Summer would have entailed, and eventually the strength to which the day fighter force was to expand by April, 1941, was fixed at 64 squadrons.

78. When April came, this figure had been duly reached. However, once again the position was less strong than it appeared on paper. Of the 64 day squadrons shown in the Order of Battle, two and a half were still in process of formation and two, although formed, were temporarily out of the line. The effective strength amounted, therefore, to 59½ squadrons. Many of them had considerably less than their established complement of pilots, and the general level of experience was substantially below that of the previous Autumn.

79. On the other hand, the opposing forces had been weakened numerically by the withdrawal of Units to the Mediterranean and Balkan theatres, and were soon to be reduced still further by withdrawals to Eastern Germany and Poland in preparation for the campaign against Russia.

80. In the event, of course, the mass attacks made by the Germans in the Summer of 1940 were never to be repeated on a comparable scale, so that after the opening of the Russian campaign, the day fighter force, although still charged with important defensive duties such as the protection of coastwise shipping and the interception of bomber reconnaissance aircraft flying singly, became largely an instrument for containing enemy forces in Northern France and attempting to compel the return of Units from the Eastern Front.

81. But even then the strength of the Russian resistance could not be foreseen; it still seemed likely that the Germans might bring the Eastern campaign to a 'successful conclusion within a measurable time and then renew their daylight offensive in the West. Accordingly, further additions were made during the second half of 1941 to the day fighter force, which, despite the despatch of seven squadrons overseas in December, reached the end of the year with a strength of 75 squadrons.

(ii) *Operations, November, 1940, to February, 1941.*

82. It has been said that, although October 31st, 1940 is now regarded as the last day of the Battle of Britain, the fact that the battle had ended on that day was not apparent at the time.

83. Indeed, the first few days of November, far from constituting a lull, were days of exceptional activity. Nevertheless, 1st November did appear to mark the beginning of a new phase of the offensive. For on that day the Germans turned to a form of attack with which they had opened the battle some months earlier, by sending over bombers and dive-bombers with fighter escort to attack our shipping in the Thames Estuary and the Dover Strait.

84. Before this no mass attacks on shipping had been made for many weeks. The Ju87 dive-bomber, which appeared in substantial numbers on that day, had not been reported in action since 18th August although it now appears that, unknown to the Command and apparently also to the Air Ministry, these aircraft may have been used against shipping at

least once in September. When further attacks followed on the next day, it seemed clear that a new stage of the battle had been reached, and on 4th November the Air Officer Commanding No. 11 Group issued orders which detailed the tactical measures required to defeat this new move.

85. Both before and after the issue of these orders the fighters reported excellent results, especially against the German dive-bombers and the Italian aircraft which took part in a few of the attacks. Doubtless for this reason, the mass attacks on shipping ceased on 14th November and from that date the Ju87 virtually ceased to be employed in daylight operations on the Western Front.

86. Despite its brevity this phase was important, for it brought to a head a conflict between the claims of shipping and the aircraft industry, which had long been a source of anxiety to my predecessor.

87. Since the beginning of the War the primary task of the Command, as laid down in a directive issued by the Air Staff and endorsed by the Chiefs of Staff, had been the defence of the aircraft industry. The Command was, of course, responsible for the air defence of the United Kingdom as a whole, and it also had a somewhat ill-defined responsibility for the fighter protection of shipping close to the coast; but the directive made it quite clear that the aircraft industry had the first claim on the Commander-in-Chief's resources.

88. So far as action by fighters was concerned the defence of the aircraft industry and the general air defence of the country were practically inseparable tasks, for it was an axiom of air defence—though one which the Minister of Aircraft Production was reluctant to accept—that the best way of defending an objective such as a factory was to deploy fighters over the approaches to it rather than concentrate them near the objective itself.

89. This principle did not apply to the protection of shipping. The ships moved mostly on the perimeter of the air defence system and it was seldom possible to be sure of intercepting aircraft which might attack them except by detailing specified fighter units to protect them, either by flying standing patrols near the ships or the adjacent coastline or by assuming an advanced state of readiness at airfields near the coast.

90. The inherent extravagance and relative inefficiency of standing patrols has always been recognised by students of air defence problems; nevertheless there are occasions in which they constitute the only practicable method of defence, and in this case they were the form of protection which the Naval authorities preferred and for which they constantly pressed.

91. It was not always possible, however, to place our fighters on standing patrol near a convoy without exposing them to the risk of being caught at a tactical disadvantage by the enemy. Another difficulty was that regulations imposed for the benefit of the ships themselves forbade our pilots to come close to the ships, virtually on pain of being fired at.

92. In spite of these difficulties and uncertainties, loyal attempts were made from the beginning of the War to give every practicable

assistance to the Royal Navy in their task of safeguarding the convoys whenever they were within range of our fighters. At the same time, attempts were made to place the matter on a more satisfactory basis, and in particular to obtain from the Air Ministry a clear statement of the Command's duties in respect of shipping and the degree of priority to be accorded to them. These attempts culminated at the end of October and beginning of November, 1940, in the receipt of a series of communications from the Secretary of State for Air which gave renewed sanction to the Command's existing practice of protecting convoys whenever possible by holding fighters at readiness rather than flying standing patrols; confirmed that the defence of the aircraft industry was still the primary task of the Command; but added that convoys, and also flotillas and minesweeping craft, must be protected so long as their protection was practicable.

93. This pronouncement did not end my predecessor's perplexities, since—perhaps inevitably—it neither defined the practicable nor assisted him to determine how much of his resources he would be justified in diverting from his primary task to what was clearly a secondary—and yet, apparently, essential—one.

94. The difficulty of the problem will be the more easily grasped if it is borne in mind that, at this stage of the war, practically the whole resources of the Command could have been expended on either of these rival tasks, without glutting the appetite of the Minister of Aircraft Production in the one case or the Naval authorities in the other.

95. The renewal of mass attacks on shipping at the beginning of November brought fresh demands from the Naval authorities. Accordingly, my predecessor again asked the Air Ministry, this time by means of a formal letter, to clarify their policy in regard to the fighter protection of shipping. In this letter he placed before the Air Ministry a series of proposals based on the practice which had grown up gradually within the Command.

96. No reply to this letter had been received when I took up Command, and I therefore assumed the Air Ministry's tacit consent to the proposals. Henceforward three degrees of fighter protection for shipping were recognized, namely *close escort*, to be given only in special cases and by prior arrangement; *protection*, which meant that specified fighter units were detailed to defend specified shipping units in a given area and over a given period, either by flying patrols or remaining at readiness; and *cover*, which meant that note was taken of the position of the shipping, and arrangements were made to intercept any aircraft which appeared to threaten it.

97. Fortunately the scale of attack against coastwise shipping declined considerably after the middle of November. In the circumstances the Naval authorities remained, to all appearances, reasonably contented with a standard of protection which would probably not have satisfied them had the attacks of early November continued.

98. Only four ships were sunk by air action within fighter range in December 1940, and only two in January 1941, as against eleven in November.

99. Apart from operations against shipping, the enemy continued in November to make the fighter and fighter-bomber sweeps over Kent and Sussex which had been a feature of his operations in October. But in November these sweeps were made at less extreme altitudes than in October, perhaps to avoid causing condensation trails or to reduce the strain on pilots. Consequently they were rather easier to counter. Heavily casualties were inflicted on the enemy's fighters as well as his dive-bombers, and in this month No 11 Group claimed the highest proportion of enemy aircraft destroyed to their own pilots lost which had yet been recorded.

100. The fighter sweeps virtually ceased in the middle of December and were resumed on a reduced scale in February. In the meantime the Germans made a number of so-called "pirate" raids on aircraft factories and similar objectives. These raids were made by single aircraft, flying over carefully prepared routes, often in cloudy weather. The German pilots showed great skill in taking advantage of every favourable circumstance of topography and weather to elude the defences. Although the raids were too infrequent to do much harm to our war potential, they caused some anxiety and resulted in great pressure being put on me to provide local fighter protection for the threatened factories.

101. The unsoundness of this method of defence, which, if carried to its logical conclusion, would have been impossibly extravagant and would have exposed our fighter force to defeat in detail, needs no elaboration. Nevertheless the Minister of Aircraft Production was so insistent that eventually I devised a scheme whereby a number of aircraft factories were to be allotted fighters for local defence, these to be piloted by the firms' own test pilots. Although put into effect later in the year, the scheme achieved little practical success and was eventually allowed to fall into abeyance. As to its thorough unsoundness from the military viewpoint there can be no doubt; but I think that it may have been worth while at the time simply for its moral effect. Workers who, seeing no fighters in the immediate neighbourhood of their factory, were unaware of the protection that they were receiving from the general air defence system, may have been and probably were heartened by the knowledge that there was a fighter on the factory airfield expressly for the purpose of defending them.

102. A more important measure taken at this stage concerned the flying of Balloon Barrages. On the outbreak of War the intention had been to fly the balloons at all times. This practice proved so expensive, chiefly because of the large number of balloons carried away or damaged by bad weather, that it soon gave way to a system whereby balloons were close-hauled in doubtful weather and raised only on the approach of hostile aircraft. The disadvantage of this system was that the weather conditions in which balloons were likely to be close-hauled were precisely those in which a "pirate" raider might hope to approach its target undetected, or at least without its purpose being divined in time for the barrage to be raised. Thus, if the barrage commanders interpreted their freedom to close-haul the balloons too liberally, there was a risk that

the barrages would be out of action just when they were most needed.

103. The experience of the "pirate" raids revealed this danger. In consequence I overhauled the machinery which had been set up to inform barrage Commanders of the approach of hostile aircraft, and laid down the principle that some risk of damage to balloons by bad weather must be accepted and that all barrages must be kept flying by day unless there were really strong grounds for close-hauling them.

(iii) *Operations, March to December, 1941.*

104. At the end of February a decision was reached at the highest level to give absolute priority to the defence of shipping in the North-Western approaches, which was now dangerously threatened by a combination of U-boats and long-range aircraft.

105. The measures taken in consequence of this decision included the transfer to Northern Ireland of some Units of Coastal Command which had hitherto shared with my Command the task of protecting coastwise trade off the East Coast. Consequently, when announcing this decision on 28th February, the Air Ministry instructed me to provide additional "watch and ward" for this traffic, at the expense, if necessary, of other tasks. At the same time I was warned of the possibility of increased attention by the German bomber force to West Coast Ports.

106. These instructions were followed on 9th March by a directive which made the defence of the Clyde, the Mersey and the Bristol Channel my primary task.

107. As has been seen in discussing night operations, I made arrangements in consequence of these instructions to increase the A.A. and night-fighter defences of the West Coast Ports. At the same time, I increased the day-fighter defences of the Bristol Channel and the Mersey by bringing into operation Nos. 118 and 316 (Polish) Squadrons, which had been training for some time past at Filton and Pembrey, and by moving the newly-formed No. 315 (Polish) Squadron to Speke. I did not consider that any addition was necessary to the day-fighter defences of the Clyde, as No. 602 Squadron was already at Prestwick, while Nos. 43, 603 and 607 Squadrons at Turnhouse and Drem could quickly be made available as reinforcements.

108. On 5th March I gave instructions to all the Fighter Groups to allot a greater proportion of their effort to the protection of shipping and ports. The system of giving "escort", "protection" or "cover" to convoys, according to circumstances, remained in force, but I arranged that "escort" should be given more generously than hitherto in specially dangerous areas, and that, where attacks were likely to be made without warning, fighters giving "protection" should be kept airborne while the risk continued.

109. The practical effect of these instructions is best shown by a few statistics.

110. In February 1941, my Command devoted to the protection of shipping 443 sorties, or eight per cent. of its total defensive effort by day; in March 2,103 sorties, or eighteen per cent.; and in April 7,876 sorties, or 49 per cent. During April several Squadrons in No. 10 Group each spent more than 1,000 hours of flying time in the discharge of this

task. In no ensuing month of 1941 was the proportion of the total defensive effort of my Command by day which was devoted to the protection of shipping less than 52 per cent., the highest proportion being 69 per cent. (in August and again in September). The smallest number of daylight sorties expended on this duty in any month after March was 3,591 (in December) and the largest 8,287 (in May).

111. Besides providing this vastly increased scale of fighter protection, I surrendered from the resources under my operational control, a number of light A.A. weapons for installation in merchant vessels. Other forms of armament now provided for these vessels included rocket projectors and parachute-and-cable projectors.

112. In consequence of these measures the Germans were forced to make an increasing proportion of their attacks under cover of darkness or twilight. After rising to a peak of 21 ships in March, the number of ships sunk by an action in daylight within the radius of fighter action fell to negligible proportions.

113. Various means of protecting ships at night as well as by day were tried, but after dark fighters were at a disadvantage, since their presence tended to confuse the ships' gunners and thus do more harm than good. On the whole the best form of protection for merchant vessels after nightfall proved to be a combination of the A.A. weapons carried by the ships themselves and their escort vessels, and the orthodox use of night-fighters to intercept enemy bombers wherever they could be most conveniently engaged. On the other hand it was important not to withdraw escorting fighters too early, since the Germans were quick to seize opportunities of attacking ships at dusk. At the end of the last patrol of the day, therefore, fighters had to be landed in the dark. Conversely it was necessary for the earliest patrols to take off long before dawn in order to be in position by "first light."

114. A word of tribute is due to the pilots who undertook these unspectacular and often tedious duties. Convoy patrols gave pilots comparatively few chances of distinguishing themselves in combat with the enemy, yet they constituted an essential, often exacting, and sometimes hazardous task, since the possibility of a sudden deterioration in the weather, which might render the handling of a high-performance fighter a business requiring all the pilot's skill, was always to be reckoned with.

115. There remained the problem of protecting shipping outside the radius of action of the short-range fighter. Hitherto my Command had not been concerned with this; but in the Spring of 1941 the Air Ministry announced a decision to equip a number of merchant vessels as "Catapult Aircraft Merchant Ships". At least one of these "C.A.M. Ships" would form part of every Atlantic convoy. Each would carry a Hurricane fighter, which could be launched by rocket-catapult on the approach of an enemy aircraft. On completion of his patrol the pilot would either bale out, alight on the sea, or, if near the coast, make for an airfield on land.

116. In order to provide the necessary complement of pilots, the formation of the Merchant Ship Fighter Unit began at Speke, in No. 9 Group, early in May 1941. I also made arrangements to train a number of Naval Officers as

"Fighter Directing Officers". The latter were to sail in the C.A.M. ships and, making use of radar and radio-telephony equipment, direct the fighters towards approaching German aircraft. The Merchant Ship Fighter Unit absorbed the equivalent of approximately two fighter squadrons.

117. The Unit despatched its first pilots and maintenance crews on operational service early in June. In August a detachment opened at Dartmouth, Nova Scotia, to administer a pool of replacement aircraft on the Western side of the Atlantic.

118. German aircraft continued to make occasional "pirate" raids on factories and other objectives in the Spring, but thereafter activity by day, apart from operations against shipping, consisted almost entirely of reconnaissance flights and occasional "tip-and-run" attacks on coast towns in England and Scotland. Offensive operations by German fighters virtually ceased in the early Summer. On a few occasions in the Autumn Merop fighters were seen over Kent and Sussex, but the only offensive action worthy of the name which was taken by German fighters in the second half of 1941 was on Christmas Day, when two aircraft appeared off the South Coast and opened fire on buildings near Hastings. This was the prelude to a new low-level fighter and fighter-bomber offensive which was to take place in 1942.

119. The interception of "pirate" raiders and other aircraft flying singly was a difficult task, especially in cloudy weather, when problems arose similar to those which surrounded night interception. As early as December 1940, the principle of using Beau-fighters fitted with A.I. by day in bad weather was established, and as experience grew it became evident that in such conditions the only reasonable chance of success was offered by the same combination of A.I. in the aircraft, and G.C.I. on the ground, as was used at night.

120. The next step was the use of G.C.I. by day for controlling fighters without as well as with A.I. In August 1941, I made provision for this to be done throughout Nos. 10 and 11 Groups, although at this stage G.C.I. Stations in No. 11 Group were not required to keep watch by day in good weather.

121. Another step taken about this time was the development of a plan for intercepting aircraft capable of flying at very great heights, which it was thought that the Germans might be planning to use against us. After fighters of No. 10 Group had practised making very high-altitude G.C.I. interceptions of Fortresses of Bomber Command, my staff devised a system of control whereby the country was divided into a number of regions each containing an "area control" connected with a "central control" designed to co-ordinate their activities. This scheme was to prove useful in 1942 when the Germans sent a number of high-flying Ju86 P reconnaissance aircraft over this country.

122. With the decline in the volume of over-land activity by the Luftwaffe towards the end of 1941, I considered it reasonable to contemplate a relaxation of the principles of balloon-barrage control which had been re-affirmed in the Spring. Technical improvements which made it possible to raise balloons to their operational height more quickly than hitherto

favoured a change which seemed called for by an increased volume of flying by our own aircraft, to which the barrages were in some circumstances an impediment. In November trials were made with a system whereby a large number of provincial barrages were grounded throughout the 24 hours except when German aircraft were known to be about. It was not until 1942, however, that this system was finally adopted.

(b) *Offensive.*

(i) *Operations up to 13th June, 1941.*

123. During the Battle of Britain the initiative in daylight operations lay with the Germans. Nevertheless, even before the battle was over a time was foreseen when our fighter squadrons would seize the initiative and engage the German fighters over the far side of the Channel. The necessary operational instructions were drawn up as early as the third week in October, 1940, and revised in the first week of December.

124. By the latter date it was possible to contemplate something more ambitious than a mere pushing forward of fighter patrols, and on 29th November, I instructed the Air Officer Commanding No. 11 Group to look into the possibility of combining offensive sweeps with operations by Bomber Command.

125. In the middle of December the German fighter force, which had suffered heavy losses since the Summer, virtually abandoned the offensive for the time being. Clearly, the moment had come to put our plans into effect and wrest the initiative from the enemy.

126. Broadly speaking, the plan which we now adopted visualized two kinds of offensive operations. In cloudy weather, small numbers of fighters would cross the channel under cover of the clouds, dart out of them to attack any German aircraft they could find, and return similarly protected. In good weather fighter forces amounting to several squadrons at a time, and sometimes accompanied by bombers, would sweep over Northern France. The code-names chosen for these operations were respectively "Mosquito" (later changed to "Rhubarb," to avoid confusion with the aircraft of that name) and "Circus"; but in practice it was necessary to restrict the name "Circus" to operations with bombers, and fulfilling certain other conditions which will become apparent as this account proceeds.

127. "Rhubarb" patrols were begun on 20th December, 1940, and provided valuable experience alike for pilots, operational commanders, and the staffs of the formations concerned. I encouraged the delegation of responsibility for the planning of these patrols to lower formations, and many patrols were planned by the pilots themselves with the help of their Squadron Intelligence Officers.

128. It was obvious from the start that in many cases pilots engaged on these patrols would not succeed in meeting any German aircraft, and they were authorised in this event to attack suitable objectives on the ground. Nevertheless, I considered it important that the primary object of the operation—namely, the destruction of enemy aircraft—should not be forgotten, and discouraged any tendency to give undue emphasis to the attacks on ground objectives.

129. Between 20th December, 1940, and 13th June, 1941, 149 "Rhubarb" patrols, involving 336 sorties, were flown, of which 45 were rendered abortive by unsuitable weather or other extraneous circumstances. German aircraft were seen in the air on 26 occasions, to a total of 77 aircraft, and on 18 occasions were engaged. The destruction of seven enemy aircraft was claimed for the loss of eight of our pilots, and 116 separate attacks were made on a variety of surface objectives, including ships, road vehicles, airfield buildings, grounded aircraft, artillery and searchlight posts, German troops and military camps.

130. Operations on a larger scale began with a sweep off and over the coast of France by a total of five squadrons of fighters on 9th January, 1941. The first operation with bombers followed on the next day, when dispersal pens serving landing grounds on the edge of the Foret de Guines, South of Calais, were attacked. Altogether eleven of these "Circus" operations were executed up to 13th June, the objectives for the bombers including the docks at Dunkirk, Calais and Boulogne, a number of airfields and one industrial plant known to be working for the Germans. In addition more than forty sweeps were made during this period by fighters without bombers.

131. After the first three "Circus" operations an inevitable difference of view between Bomber and Fighter Commands as to the primary object of these attacks became apparent. The principal aim of my Command was to shoot down enemy aircraft, while Bomber Command, naturally enough, attached more importance to the bombing. It was, however, the view of the Chief of the Air Staff that the bombing of objectives in France with the resources available for operation "Circus" could have no decisive military effect at this stage of the War, and that it would be a pity to spoil the chances of the fighters by making them conform to the requirements of a bomber force bent exclusively on inflicting material damage by bombing, and prepared to linger over the target area for that purpose. On his instructions, the Air Officer-Commanding-in-Chief, Bomber Command, and myself, held a conference at my Headquarters on 15th February, 1941, when we agreed that the object of operation "Circus" was to force the enemy to give battle in conditions tactically favourable to our fighters. To compel the Germans to do so, the bombers must do enough damage to make it impossible for them to refuse to fight.

132. The early "Circus" attacks were not always successful in producing these tactically favourable conditions, even after agreement on this point had been reached. This was largely because, in practice, there was still a tendency for our forces to operate too low down. There is no doubt that ideally our lowest fighter squadron should never have flown at less than about 18,000 feet, the highest being somewhere about 30,000 feet. To achieve this it would have been necessary for the bombers invariably to fly at 17,000 feet or more. This was not always practicable, if only because of the time required by the Blenheim bombers then used for these operations to reach that height. Nevertheless, it was thought advisable to lay down this principle as a *desideratum*, and this was done when I issued fresh instructions for

operation "Circus" during the third week in February. In the next three operations the bombers flew at heights between 15,000 and 17,000 feet and in the following two at 10,000 and 12,000 feet respectively.

133. Towards the end of May the weather declined, and between 22nd May and 13th June no "Circus" operations were attempted. Up to this point no major fighter battle had occurred, the enemy having been content, on the whole, to pounce on stragglers or otherwise attempt to exploit any favourable tactical situation which might develop. In the absence of such favourable circumstances he had usually avoided combat. In this sense the operations had proved slightly disappointing. On the other hand, statistically the results were fairly satisfactory so far as they went, the destruction of 16 aircraft and probable destruction of a substantial number of others being claimed for the loss of 25 of our pilots; and much valuable experience had been gained. Moreover, by a combination of "Circus" and "Rhubarb" operations our ultimate object, which was to seize the initiative, harass the enemy, and force him on to the defensive, had undoubtedly been achieved.

134. Besides these "Circus" operations, fighter sweeps, and "Rhubarb" patrols, a series of bombing attacks on shipping and what were called "fringe targets" by aircraft of Bomber and Coastal Commands, with fighter escort, were made between 5th February and 12th June, 1941. These operations differed from "Circus" operations inasmuch as the primary object was not to force enemy fighters to give battle, but to damage or destroy the target. The fighter force therefore conformed to the requirements of the bomber force and did not seek battle unless attacked.

135. Sixteen such operations were undertaken during the period stated, the size of the bombing force ranging from three to eighteen aircraft, and that of the fighter escort from one flight to eight squadrons. A number of combats with German fighters developed, in which we claimed the destruction of one German aircraft for approximately every one of our pilots lost. A considerable volume of fighter-reconnaissance was carried out in connection with these operations.

(ii) *Operations, 14th June to 31st December, 1941.*

136. On 14th June an improvement in the weather permitted the resumption of the "Circus" offensive, and an operation which had been planned towards the end of May was put into effect. A similar operation on 16th June was followed on 17th June by the most ambitious "Circus" yet attempted. This involved an attack on a Chemical Plant and Power Station near Bethune by eighteen Blenheim bombers, escorted by no less than 22 squadrons of fighters. The enemy fighter force reacted vigorously, and although we lost nine pilots, those who returned reported a very favourable outcome of their combats. It seemed that the long-expected "fighter battle on terms tactically favourable to ourselves" had come at last.

137. On the same day the Chief of the Air Staff instructed me to devise, in consultation with my colleagues at Bomber and Coastal

Commands, the most effective means possible of checking the withdrawal of Luftwaffe Units to the East—where the German attack on Russia was imminent—and, if possible, forcing the enemy to return some of the Units already withdrawn.

138. A meeting to discuss this question took place at my Headquarters, on 19th June, and was attended by the three Commanders-in-Chief and members of our staffs and by the Air Officer Commanding No. 11 Group and two of his staff.

139. We came to the conclusion that the best plan would be to attack objectives within range of escorting fighters—in other words, to intensify the "Circus" offensive. Since the enemy had reacted most energetically so far to the "Circus" against a target near Bethune on 17th June and another against a target in that area on 21st May, we concluded that the industrial area which included Bethune, Lens and Lille was probably his most sensitive spot. By attacking this area it was hoped to induce him to concentrate in North-East France such fighter units as he still had in the West. Bombers without escort might then hope to reach West and North-West Germany in daylight round the flank of the defences, and this in turn might force the enemy to bring back fighters from the Eastern Front in order to defend the Fatherland.

140. As a corollary to this offensive, night attacks would be made on communications in the Ruhr, and shipping attempting to pass through the Straits of Dover would also be attacked. This two-pronged offensive would, we thought, constitute a threat to communications between France and Germany which the enemy could not afford to ignore.

141. These proposals met with the approval of the Air Ministry, and an agreed list of "Circus" objectives was drawn up. It was arranged that aircraft of No. 2 Group, Bomber Command, should attack them in co-operation with fighters of my Command, and, as a secondary task, should also attack shipping and "fringe targets."

142. On 3rd July, the Air Ministry informed me that the formula defining the object of operation "Circus," which had been agreed upon in February, must be abandoned and that the object must now be "the destruction of certain important targets by day bombing, and incidentally, the destruction of enemy fighter aircraft."

143. Two days later Stirling bombers of No. 3 Group were used in these operations for the first time instead of Blenheims of No. 2 Group. This change, together with the tactical adjustment which the new policy laid down by the Air Ministry made necessary, imposed a slight and temporary handicap on the fighter force. As soon as experience had been gained under the new conditions, a small formation of Stirlings was found to suit the fighters better than a larger formation of Blenheims. Towards the end of the month the Stirlings ceased, however, to be available for "Circus" operations, as Bomber Command required them exclusively for other purposes.

144. During the first few weeks of the intensive period, which may be regarded as beginning on 14th June, our pilots reported outstandingly good results in combat, and

early in July it seemed that something like complete ascendancy had been gained over the opposing fighter force. For a short time in the middle of June the German fighter-pilots had offered determined opposition, but they now seemed, as in the Spring, reluctant to engage unless specially favoured by circumstances.

145. The results reported by our pilots during the next few weeks were not quite so good, although still much in our favour, and at the end of July the Air Ministry decided to review the results achieved up to this time.

146. To assess these results with any approach to accuracy was a matter of great difficulty. Our pilots had reported the destruction of enemy fighters in large numbers; but in operations on this scale there is room for much honest error, and even if the claims were accepted at their face value, it was impossible to know how many German pilots had baled out of their damaged aircraft, descended safely by parachute, and lived to fight another day. We believed that our information about the enemy's Order of Battle was good—as, indeed, it subsequently proved to be—but our knowledge of his capacity to replace losses was scanty. We had good reason to think that so far our attempt to force the Germans to bring back units from the Eastern Front had failed, but suspected that towards the end of July some experienced individual pilots had returned in order to stiffen up the mass. We also had information which suggested that reserve training units in France had been called upon to replace losses. The effect of the bombing attacks was virtually unknown.

147. As for our own losses, so far as Fighter Command was concerned these had been heavy, but not so heavy as to cause serious embarrassment. Our losses in pilots during the first two weeks of the intensive period had been far lighter than at the height of the Battle of Britain; and our losses in aircraft over the same period not beyond our capacity to replace. Bomber Command had lost fifteen aircraft in "Circus" operations since 14th June, and in the course of a daylight attack on German capital ships at Brest and La Pallice had suffered the rather more serious loss of sixteen bombers out of 115 despatched.

148. Losses like this, incurred when attacking an objective on the left flank of the German defensive system, suggested that attacks round the right flank into Germany might not prove such a practicable undertaking as had been hoped.

149. It was in these circumstances that a conference was held at the Air Ministry on 29th July to decide whether "Circus" operations should continue. It was agreed that some of the conceptions formulated at the conference of the Commanders-in-Chief on 19th June had been too sanguine; the daylight bombing of Germany, in particular, no longer looked like being practicable on any appreciable scale for some time to come, and it was agreed that for the medium and heavy bombers of Bomber Command night operations should normally take precedence over day operations. On the other hand it was equally clear that, if anything was to be done to contain the enemy fighter force in the West, offensive operations by Fighters must not cease; and it seemed to

me that the co-operation of a bomber force was necessary to make these operations effective. The Chief of the Air Staff upheld this view; and it was decided that the "Circus" offensive should continue.

150. Up to this time 46 "Circus" operations had been carried out since 14th June. In those six weeks escort and support had been given to 374 bomber sorties and over 8,000 fighter sorties flown. We had lost 123 fighter pilots but it was hoped that many more German fighters than this had been destroyed. In addition, over 1,000 fighter sorties had been flown in support of 32 bomber operations against shipping, including the operations against the German capital ships on 24th July and an attack on the docks at Le Havre on 19th June. Fighter sweeps without bombers accounted for approximately another 800 sorties, and operation "Rhubarb"—resumed on 16th July after a month's pause—for a further 61. Altogether the six weeks' intensive effort had meant the expenditure of nearly 10,000 offensive sorties by my Command. This was an impressive total, but to preserve perspective it must be remembered that the effort devoted to defensive purposes was still greater, approximately this number of sorties being expended during the same period on the protection of shipping alone.

151. The "Circus" offensive was resumed on 5th August and 26 operations were carried out during the month. Blenheims of No. 2 Group provided the striking force for 24 of them and Hampdens of No. 5 Group for the other two. As the enemy gained experience in repelling these attacks his opposition grew more effective, and the balance of advantage showed a tendency to turn against us. This being so, it was for consideration whether the scale of the offensive should be reduced, if not at once, at any rate as soon as there was any sign of a more stable situation on the Eastern Front.

152. Apparently the same considerations occurred simultaneously to the Chiefs of Staff. Consequently, the problem was studied at the end of August and beginning of September in the Air Ministry as well as at my Headquarters and at Headquarters No. 11 Group. The outcome was that, although it was now clear that the offensive had not succeeded in forcing the return of German Units, at any rate in substantial numbers, from the Eastern Front, and could not now be expected to do so, it was generally agreed that it ought to be continued, although on the reduced scale which the declining season was likely to impose in any case. A suggestion made by the Air Officer Commanding No. 11 Group, which I endorsed, was that, instead of being largely concentrated against the French departments of the Nord and Pas-de-Calais, the attacks should now be delivered over a wider area so as to induce the Germans to spread their fighters more thinly along the coasts of France and the Low Countries.

153. Accordingly, twelve "Circus" operations were carried out in September and two during the first week of October. The objectives attacked by the bombers included two targets at Rouen, one at Amiens, one at Le Havre and one at Ostend.

154. By this time it was clear that demands from other theatres of war were likely to cause a shortage of fighter aircraft at home for some time to come. For this reason, and also because the weather was growing less favourable and the situation on the Eastern Front had reached a stage at which it was unlikely to be materially affected by the "Circus" offensive, on 12th October I instructed the three Group Commanders concerned with offensive operations that in future "Circus" operations must only be undertaken in specially favourable circumstances, but that a rigorous offensive should be continued against shipping and "fringe targets".

155. Early in October the Hurricane bomber, which had been under development for some time, became available for active operations, and armed with this weapon the Command assumed responsibility for what was called the "Channel Stop". The object of this operation, which hitherto had been performed mainly by Blenheims of No. 2 Group with fighter escort, was to close the area between the North Foreland, Ostend, Dieppe and Beachy Head to all hostile shipping by day.

156. When the Air Ministry decided to reduce the scale of the "Circus" offensive in September, I made arrangements at their instance to increase the scale of scope of operation "Rhubarb". Hitherto pilots had seldom been lucky enough to meet German aircraft, so that their only alternative to inaction had been to make rather aimless attacks on surface objectives. I might have taken advantage of this situation by imposing a rigid "target policy," but up to the present I had judged it inadvisable to lay down any rule which might give the impression that attacks on surface objectives were as important as the destruction of enemy aircraft. Pilots were therefore given a free hand in this matter so long as they observed the general bombardment instructions which reflected the attitude of H.M. Government to questions of humanity and international law.

157. Although the relative importance of enemy aircraft and surface objectives as objects of attack had not changed, my staff and I felt that the time had come to subordinate the ideal to the real by recognizing that on nine occasions out of ten our pilots were not likely to see any German aircraft and must either attack surface objectives or do nothing.

158. Accordingly, new instructions for operation "Rhubarb" were issued in October. Pilots were now to proceed to a selected surface objective, and if they met no German aircraft on the way, that would be their target. If they did meet German aircraft, then the destruction of those aircraft would take priority.

159. Categories from which the surface objectives were to be selected were drawn up by my staff in consultation with the Air Ministry; they included canal barges, railway tank wagons, electrical transformer stations and, for a season, factories engaged in distilling alcohol from beet. On 20th October, H.M. Government withdrew a long-standing ban on the attack of moving goods trains, so that we could now attack tank wagons on the ^{move} as well as in sidings.

160. Factories distilling alcohol and a number of other targets on land were also attacked in November by fighter-bombers with fighter escort. The fighter-bombers, which attacked from heights below 5,000 feet, suffered rather heavy losses from A A fire in these operations and also in some of their attacks on shipping. In the past the Blenheim bombers used by No 2 Group for these "shipping strikes" had come up against the same difficulty, despite attempts by accompanying fighters to silence the German gunners by attacks with cannon and machine-guns.

161. Meanwhile, on 21st October, I carried the reduction in the scale of the "Circus" offensive a stage further by imposing on No. 11 Group, as the Group principally concerned, a limit of six such operations a month.

162. In practice there was only one "Circus" after this date. This was carried out on 8th November in conjunction with a high-level fighter sweep and a low-level attack by fighters and fighter-bombers on an alcohol distillation plant. An unexpectedly high wind added to the difficulties of the undertaking, which resulted in the loss of sixteen fighter aircraft and thirteen pilots. Later in the day another aircraft and its pilot were lost in the course of a fighter sweep.

163. Although not by any means disastrous, losses on this scale were unwelcome in view of the shortage of aircraft that was expected to make itself felt during the next few months. I therefore decided to restrict No. 11 Group to three "Circus" operations a month in future instead of six.

164. A few days later the Air Ministry informed me that the War Cabinet had called attention to the desirability of conserving resources in order to build up strong forces by the Spring of 1942. Since the wording of the letter in which the Air Ministry conveyed this information made it clear that no risks must be taken by pressing attacks in unfavourable weather, I now imposed a still more stringent limitation on the Air Officer Commanding No. 11 Group, who was asked to undertake no more "Circus" operations without reference to me.

165. The outbreak of War between the United States of America and Japan in December provided still further grounds for conservation, since it was clear that the supply of aircraft from America was likely to cease or at least be greatly reduced for some time to come. Consequently the constant drain imposed by even minor operations could no longer be afforded.

166. In point of fact, wintry weather was already upon us, and after 8th November no more "Circus" operations were carried out. The intensity of our other offensive operations was also substantially reduced as the year drew to its close.

167. A word must be said here about some of the special offensive operations, outside the normal "Circus", anti-shipping, fighter-sweep and "Rhubarb" categories, in which the Command participated between 14th June and the end of 1941.

168. Reference has already been made to Bomber Command's attack on the German warships at Brest and La Pallice on 24th July.

In connection with this operation six squadrons of fighters from No. 11 Group provided escort for two diversionary attacks on Cherbourg and another fourteen took part in a "Circus" against Hazebrouck, while the equivalent of nine squadrons from No. 10 Group gave support over Brest and the Western end of the English Channel. Since only five squadrons of single-seater fighters with long-range tanks were available, the degree of support that could be given over Brest was necessarily disproportionate to the size of the bomber force, which suffered accordingly.

169. On 12th August a force of 54 Blenheims of Bomber Command attacked two Power Stations at Cologne in daylight. A squadron of Whirlwinds accompanied them on the first 135 miles of their outward journey, and on their return journey a wing of long-range Spitfires met them near the Dutch Coast, while another Spitfire wing made a sweep over Flushing in support. Two "Circus" operations over France by a total of nineteen fighter squadrons and twelve Hampdens of Bomber Command were carried out as diversions. Eleven aircraft of the bomber force despatched against the Power Stations were lost, but Bomber Command expressed themselves as well satisfied with the results achieved. In the light of our subsequent knowledge of the enemy's system of deploying and controlling fighters at that time, it now appears unlikely that diversions so far from the scene of the main attacks could have had any effect on the opposition in that area.

170. On 18th December and again on 30th December, Bomber Command made further attacks on the German warships at Brest. Fighter support was provided by ten and nine squadrons of the Command respectively. As before, the results were satisfactory from the fighter aspect, but once again the bombers suffered substantial losses.

(iii) *Results Achieved by the Offensive.*

171. It would be unwise to attach too much importance to statistics showing the claims made and losses suffered by our fighters month-by-month throughout the offensive.

172. The experience of two wars shows that in large-scale offensive operations the claims to the destruction of enemy aircraft made by pilots, however honestly made and carefully scrutinized, are a most inaccurate guide to the true situation. Moreover, the results achieved by an offensive can rarely be judged by a mere statistical comparison of casualties suffered and inflicted. Except when an operation has been launched purely for the purpose of procuring the attrition of the opposing force, a broader view than this must be taken of the strategic purpose and the extent to which it has been achieved.

173. In the present case the original object was to wrest the initiative from the enemy for the sake of the great moral and tactical advantages bestowed by its possession. Later the Command was entrusted with the task of co-operating with Bomber and Coastal Commands in order, first to prevent the enemy from withdrawing any more flying units from the Western Front after the middle of June, and secondly to induce him to return some of the units already withdrawn by that time. These may be

designated respectively objects numbers one, two and three.

174. Object number one was achieved within a few months of the opening of the offensive. By the Spring of 1941 the initiative in major daylight operations had passed from the Germans, who did not subsequently regain it.

175. Objective number two was also achieved, inasmuch as the Germans did in fact retain on the Western Front throughout the second half of 1941 approximately the same first-line fighter force as was present in the late Spring. In particular, two Geschwader of particularly high quality, which might have been usefully employed elsewhere, remained in Northern France to oppose the "Circus" offensive and our other offensive operations. It is, of course, most unlikely that, even without the offensive, the Germans would altogether have denuded the Western Front of fighters: so long as even the threat of an offensive was present, a substantial defensive force would doubtless have been retained in the West in any case. Still, the fact remains that throughout the Summer and Autumn of 1941 roughly one third of the total establishment of German first-line single-engined fighters was contained on the Western Front.

176. Object number three was not achieved. Such moves between East and West as occurred were by way of exchange rather than reinforcement.

177. To turn to subsidiary achievements, the offensive against shipping went far to deny the Dover Strait to the enemy in daylight, so that the Germans were induced to pass more and more of their shipping at night. This produced favourable conditions for the employment of naval forces. Furthermore the offensive as a whole, and particularly the "Circus" offensive, brought about a substantial attrition of the German fighter force in Northern France during the Summer, at a substantial cost to ourselves. Such an effect could not, by its very nature, be other than transitory so long as the enemy's means of replacement remained intact; for any slackening of the offensive, whether caused by bad weather or our own losses, would enable him to restore the situation more or less quickly. One of the clearest lessons which was later seen to emerge from this experience was that fighters operating from this country over Northern France could, at a sufficient cost, inflict such losses on the opposing fighter force as would bring about a local and temporary air superiority. But this achievement could, of itself, have no decisive military value: the ability to create this situation was valuable only if means were to hand of exploiting it by some further move capable of producing a decision.

178. This condition was not fulfilled in 1941. Consequently the operations just described, although they achieved two of the three objects for which they were undertaken, and also provided valuable experience, were necessarily indecisive. This was, indeed, recognized as inevitable when the intensified offensive was begun, for its underlying strategy rested upon the assumption that the decisive theatre lay, for the moment, in the East. Nevertheless these operations pointed the way to the events of 1943 and 1944, when the temporary reduction of the opposing fighter force was to be de-

liberately and successfully undertaken as a necessary prelude to the decisive military gesture which was to lead to the defeat of Germany.

PART II: STRENGTH, FIGHTING VALUE AND ORGANISATION.

(a) *Expansion of the Operational Training System.*

179. At the beginning of November 1940, the first-line strength of Fighter Command stood nominally at 67½ squadrons. Outwardly, therefore, the Command was stronger than at the beginning of the Battle of Britain, when only 58 squadrons were available. In reality it was weaker. After several months of intensive fighting some of the squadrons had only a few pilots fully up to operational standards, and the first-line strength was backed by insufficient depth. At the height of the battle the supply of new pilots had failed to keep pace with losses and it had been necessary to improvise measures to avert a crisis.

180. Superficially this weakness was due to the inability of the operational training organisation within the Command to keep pace with our losses. In reality the trouble went deeper. It is true that if there had been a larger reserve of pilots in the Operational Training Units the decline in the effective strength of the first-line squadrons could have been avoided or postponed. But such a reserve could only have been accumulated in the first place either by withholding pilots from the first line or by increasing the supply from the Flying Training Schools. Neither course was practicable in the circumstances of the time. The real "bottle-neck" was the restricted capacity of the Flying Training Schools, and it was not within my competence to remedy this shortcoming, which was perhaps an inevitable consequence of the change from peace to war.

181. Nevertheless, this experience pointed to the desirability of expanding the operational training organisation so that full advantage might be taken of the increased supply of pilots from the Flying Training Schools which would eventually become available. On 1st November 1940, three Operational Training Units were in existence and the formation of another had been ordered. On 5th November my predecessor proposed to the Air Ministry that two more should be added and that all six should be incorporated in a Fighter Operational Training Group within the Command.

182. The sequel was the formation in December 1940 of No. 81 Group under the Command of Air Commodore F. J. Vincent, D.F.C. On 31st December, No. 81 Group assumed control of the six O.T.U.s then in existence or being formed. During the succeeding twelve months the number of O.T.U.s was increased to eleven. In the course of the year No. 81 Group did 263,604 hours flying and turned out 4,242 pilots—an average of more than 350 a month.

(b) *Pilot Strength of Squadrons.*

183. Nevertheless, the supply of pilots continued to be a source of anxiety during the greater part of the period covered by this account. The nominal establishment of a fighter squadron stood on 1st November 1940 at 26 pilots. In practice the average strength was

a little over 22. Heavy calls were already being made on the Command to send pilots to the Middle East, and it was also necessary to find instructors for the expanding operational training organisation and for Flying Training Command. In these circumstances there was little prospect of raising the strength substantially within a measurable time. For this and other reasons I agreed soon after assuming Command that the establishment of a fighter squadron should be reduced to 23 pilots.

184. In practice even this lower figure was not achieved for many months. By the beginning of January 1941, the average strength had fallen to 21 pilots a squadron, and it remained at this level until well into the Spring. Since it was thought that the Germans were likely to resume mass attacks on the United Kingdom in the Spring or Summer, this situation caused me some anxiety. The view taken by the Air Ministry was, however, that the general strategic situation and the requirements of other theatres of war justified a reduction in the strength of Fighter Command below the level postulated in the previous Winter.

185. I believe that if the Germans had delivered a second daylight offensive in 1941 with such forces as they could then have mustered, Fighter Command would have given as good an account of itself as in the previous Summer. But no second Battle of Britain was fought. Instead, the Germans turned their attention mainly to other theatres, and the initiative in the daylight battle passed to ourselves.

186. As the year went on, the benefit of the expanded operational training organisation and an increased flow of pilots from the Flying Training Schools began to be felt, so that in spite of substantial losses in offensive operations and the posting of many pilots to other Commands, Fighter Command reached the end of 1941 with a surplus of pilots in the squadrons. The proportion of seasoned veterans was, however, inevitably somewhat low, for of those who had survived, many had been claimed by other theatres and others had been assigned for the time being to other duties.

(c) *Number of Squadrons and Fighting Value.*

187. Of the 67½ squadrons in the Command on 1st November 1940, twelve were specialist night squadrons and the rest were primarily day squadrons. Shortly after this, one of the night squadrons—No. 73 Squadron—was transferred to the Middle East.

188. In December 1940, I estimated that for the adequate defence of the country in the coming Spring, 20 night and 80 day squadrons would be required.

189. The Air Ministry were unable to contemplate the provision of so large a force by the Spring. Instead, an immediate target of 81 squadrons was set and was reached by the beginning of April. This force comprised sixteen orthodox night squadrons (including one "Intruder" Squadron), one aerial mining squadron, and 64 day squadrons. Some of the squadrons had considerably fewer pilots than their establishment, but even so the force was numerically a good deal stronger in first-line

and depth than that which had resisted the German onslaught in the previous Summer. On the other hand the general level of training and experience was somewhat lower. A high proportion of the pilots who fought in the Battle of Britain were seasoned men who had fought successfully at Dunkirk or elsewhere over France and Belgium. The majority of these had now been killed or posted away and had been replaced largely by pilots who had been hurried through the O.T.U.s in the Autumn or whose operational training had been hampered by Winter weather.

190. In respect of equipment the Germans seemed at the time to be drawing ahead. Of the 64 day squadrons in Fighter Command at the beginning of April, 1941, one was equipped with the Spitfire VB and 29 had Spitfires II or Hurricanes II. The rest were equipped with types that were not altogether a match for the Me109F which the Germans were now using. However, it seems that only about half the opposing fighter force was equipped with this aircraft by the early Spring; the other half still had the Me109E. In reality, then, there was probably little to choose between the two forces in this respect.

191. On the other hand we had made a good deal of progress in the practical application of Radar to the problems of night defence, and although we were not yet capable of inflicting prohibitive casualties on the night bomber, we were in a much better position to deal with this menace than in 1940.

192. At this stage the Command was called upon to provide six squadrons as reinforcements for the Middle East, while one squadron—No. 232—was temporarily withdrawn for training in Combined Operations. Before Midsummer, however, the formation of seven new squadrons was begun, so that when, in the middle of June, I was required to intensify my offensive campaign over Northern France, the strength was back at the old figure of 81 squadrons.

193. A further expansion during the second half of the year had always been contemplated by the Air Ministry, although from my point of view it would, of course, have been preferable to have the extra squadrons in the Spring or early Summer. It was now decided that the aim should be to build up the Command, if possible, to a strength of 89 day and 25 orthodox night squadrons by the end of 1941. There was also a new requirement for units to carry airborne searchlights to assist in night interception; for this an additional ten flights, or the equivalent of another five squadrons, were required.

194. In practice the needs of other theatres made it impossible to carry out this programme in its entirety. A decision by the Air Ministry to send Beaufighters overseas, although doubtless justified in the circumstances, reduced the supply of these aircraft at home and so hampered the expansion of the night-fighter force. Again, the desirability of guarding against a German break-through at the Eastern end of the Mediterranean made it necessary for Fighter Command to surrender to the Middle East Command six more day squadrons as a contribution to a force which was to be built up for this purpose. These squadrons left England in December and after they had sailed were diverted, because of events in Malaya, to the

Far East. With them went No. 232 Squadron, which had returned to the Command in July after being absent for training in Combined Operations earlier in the year.

195. The outcome was that the Command reached the end of 1941 with a strength of 100 squadrons—comprising 23 night defensive squadrons, two "Intruder" Squadrons, and 75 day squadrons—in addition to ten "Turbinlite" Flights (as they were called), whose function was to carry airborne searchlights. In the event these "Turbinlite" Flights, despite the skill and enthusiasm of those concerned with them, were to accomplish little, for by the time they were used in substantial numbers the enemy had virtually ceased to send over the slower bombers with which they might have coped successfully.

196. Thus by the end of the year, the Command had achieved approximately the strength which I should have wished to have at my disposal in the Spring and Summer. The squadrons had, however, been drained of most of their more seasoned members, and the general level of experience was not so high as I could have wished. But since the size of the opposing force left in the West after the opening of the German campaign against Russia in June was only about a third of that which had opposed us in 1940, there is no doubt that at this stage the country was adequately defended.

197. On the other hand, the enemy was working on internal lines of communication and could have moved back units from Poland or the Mediterranean more quickly than we could have brought squadrons from overseas. It would be a mistake, therefore, to conclude that we were needlessly strong.

198. From August to December two Hurricane Squadrons were detached for service on the North Russian Front in No. 151 Wing under the command of Wing Commander H. N. G. Ramsbottom-Isherwood, A.F.C.

(d) *Expansion of Group and Sector System*

199. During the period covered by this account a considerable expansion of the Group and Sector system took place, mainly in accordance with plans laid before the period began.

200. The need for new Fighter Groups on the flanks of Nos. 11 and 13 Groups had become apparent at an early stage of the War. Indeed, a Group in the West of England was visualised in the Command's tentative plans even before war broke out. Accordingly, Nos. 10 and 14 Groups had been formed during the Battle of Britain. Thus by the beginning of November, 1940, there were five Groups and 23 Sectors in existence, as against the three Groups and eighteen Sectors required by the approved pre-war programme.

201. Furthermore, on the fall of France it had become necessary to plan a further extension of the air defence system up the West Coast. Clearly another Group would be needed to take charge of the Sectors which were to be formed in Wales and the West Midlands. Accordingly, No. 9 Group began to form at Preston early in August, 1940, and on 16th September its first Air Officer Commanding, Air Vice-Marshal W. A. McClaughry, D.S.O., M.C., D.F.C., took up his appointment.

202. At the beginning of November, 1940, the development of this Group had not yet reached the operational stage, mainly because the necessary airfields and communications were not yet ready. Consequently, such specific fighter defence as it was possible to allot to the area for which the Group would ultimately become responsible was still being provided by No. 12 Group.

203. In the middle of October special measures had been set in train to bring No. 9 Group to the operational stage as rapidly as possible. These efforts continued, with the result that on 1st December the Group was able to assume operational control of two of the four Sectors (later increased to five) which were allotted to it. By the middle of March, 1941, No. 9 Group had assumed responsibility for all its Sectors in daylight, although No. 12 Group, with its better night-flying facilities, continued to defend one Sector at night.

204. Before this a Sector, planned before the War, had been established in Ulster, where one fighter squadron was established in the Summer of 1940. At the same time improved facilities for operating fighters under the control of No. 13 Group were set up in South-Western Scotland.

205. These measures, of which some had been executed and all had been planned when the period under discussion opened, now bore fruit, and the twin problem of providing adequate defences in the West and protecting shipping between the Rhinns of Islay and the Bristol Channel was much eased in consequence.

206. In the Spring of 1941, there were six operational fighter Groups and 29 Sectors in existence. On the outbreak of war the flanks of the air defence system had stood on the Firth of Forth and Spithead, although there was an outlying detachment at Filton for the defence of Bristol. In a little over eighteen months the system had been so expanded that the Command was now able to operate short-range fighters, under close control, over almost every part of Great Britain and Northern Ireland and adjacent waters, with the exception of North-West Scotland.

207. Towards the end of 1940 the Command was asked to form two new Sectors in this last area in order that shipping in the Minches and objectives in the Western Highlands and the Hebrides might be brought under the shelter of the Fighter Command "umbrella". Although this desire was natural, its accomplishment was far from easy. There were no airfields suitable for short-range fighters on the mainland, and the nature of the country made it impossible to construct them. From a practical viewpoint there was much to be said for placing the responsibility for this distant area on Coastal Command, whose long-range fighters could operate in safety from airfields in the Hebrides. However, the Air Ministry rejected this solution, and eventually a compromise was adopted, whereby short-range fighters to be provided by Fighter Command would be supplemented by long-range fighters, which would be provided by Coastal Command. The latter would operate under Fighter Command when used for controlled interception.

208. The arrangements necessary to put this scheme into effect were not completed until

1942, and it may be noted that in the sequel, although two fighter Sectors were duly set up with Headquarters at Stornoway and Tiree, and remained in being until 1944 and 1943 respectively, it never became necessary to base there any flying units of Fighter Command.

209. In the Summer of 1941 I was instructed to provide an increased scale of defence for certain Naval anchorages in Northern Ireland and it was decided that the number of Sectors in Ulster should be increased to three. This necessitated the formation of a new Fighter Group and accordingly on 25th September, No. 82 Group under the command of Air Commodore G. M. Lawson, M.C., and with its Headquarters at Belfast, assumed operational control of these three Sectors.

210. As a result of these and other developments, the Command comprised, at the end of 1941, seven operational Groups and 33 Sectors—ten more than had existed at the beginning of the period covered by this account.

(e) *Adoption of Section of Two Aircraft and Three-Squadron Wing as Standard Tactical Units.*

211. During the Battle of Britain it became clear that from the tactical viewpoint there was much to be said for sections consisting of two or four aircraft rather than three, which was then the standard number. When a formation broke up in a dog-fight it was desirable that it should break into pairs, so that individual pilots could give and receive mutual protection. A section of three aircraft could not do this.

212. Since administrative arrangements were based on the sub-division of a squadron into two flights each comprising two sections of three aircraft, there was a conflict here between operational and administrative interests. But the tactical superiority of the section of two or four was so clear that some sacrifice of administrative convenience was obviously justified. Accordingly, it was decided that the section of two aircraft should be adopted, and in the Spring of 1941 a new sub-division of the squadron into two flights each comprising three sections of two aircraft was standardized throughout the Command.

213. Another change which arose out of experience gained in the Battle of Britain concerned the use of Wings consisting of three or more squadrons. Such wings had sometimes claimed exceptionally good results in combat with large enemy formations, and there was a body of opinion which favoured a more frequent use of them. Against this it was argued that in many cases, if time were consumed in assembling large wings, it would be impossible to attack the enemy formations before they reached their targets.

214. A conference to discuss this point was held at the Air Ministry in October, 1940. At this meeting it was confirmed that Wings of three or more Squadrons were the proper weapon to oppose large enemy formations when conditions were suitable; but as to what constituted suitable conditions for their employment no definite decision was reached. A

more concrete suggestion was that some of the squadrons in the Command should be disposed and organized in such a way as to facilitate their employment as wings when occasion called for it.

215. It was my view that the best way of defending an objective was not so much to interpose a screen of fighter squadrons between that objective and the enemy, as to shoot down a high proportion of the enemy force sent to attack it, irrespective of whether the objective was bombed on a particular occasion or not.

216. On assuming Command, therefore, I adopted the suggestion made at the conference. Provision was made to operate three-Squadron Wings from a number of Sectors in South and South-East England, and in February, 1941, the sanction of the Air Ministry was obtained for the appointment of Wing Commanders second-in-command at fifteen of the principal Stations in the Command. I arranged that these Officers should concern themselves with the operation and training of the day squadrons in their Sectors and, where there were three-Squadron Wings, Sector Commanders were encouraged to rely on them to lead the wings in battle on important occasions.

217. By that time we had turned to the offensive, and it was as an offensive weapon that I had begun to visualise the wings. If there had always been some controversy as to their practical usefulness in defensive warfare, their advantages for offensive use were clear enough. It so happened that no opportunity was to arise in 1941 to test them on the defensive, since the Germans did not resume their mass attacks of 1940. The wings became, however, an essential weapon of our own daylight offensive, which began to gather weight early in the year and was greatly intensified after the middle of June.

(f) *Growth and Development of Artillery and Balloon Defences.*

218. The development of the Group and Sector organisation in Fighter Command was accompanied by a considerable expansion of the artillery and balloon defences.

219. I exercised general operational control over these defences and was responsible for their disposition and co-ordination with other means of defence. I was not responsible for their administration nor, in the case of the artillery defences, for training or technical development, apart from the provision (during part of the period) of aircraft for anti-aircraft co-operation and exercises.

220. It is therefore necessary to mention here only a few of the more important organisational and technical changes, such as had a close bearing on the operation or disposition of the defences.

221. One of the chief of these was the re-organisation of A.A. Command which occurred at the end of 1940. Three A.A. Corps were created, the number of A.A. Divisions was increased from seven to twelve and these formations were re-grouped so as to facilitate co-operation with the formations of Fighter Command. Co-operation at the Command level had always been and remained excellent, but

to secure effective co-ordination at lower levels was more difficult. Inevitably the requirements and interests of guns and fighters must sometimes conflict, and to achieve a satisfactory adjustment between them through two different chains of command was not an easy problem. This change did not prove to be the final answer to it, but it was a step in the right direction.

222. Other important changes belonging to this period concerned the deployment of searchlights.

223. At this stage of the War searchlights were used to illuminate enemy aircraft for the benefit of both guns and fighters. In 1940 they gave disappointing results in both capacities, partly because they relied on sound locators which could seldom cope satisfactorily with the speed of the modern bomber and partly because clouds and haze often made them ineffective. As a means of overcoming the second diffi-

culty, recourse was had to the expedient of siting them in clusters of three so as to provide a stronger illumination. This arrangement was found in practice to confer no advantage sufficient to compensate for the drawback of wider spacing, and in September, 1941, General Pile and I decided that the lights should be re-sited singly. In the meantime calculations had been made to determine the size of the area in which a single night-fighter aided by searchlights could hope to effect an interception, and the pattern in which the searchlights were deployed was based on this conception. The method of operating this "fighter box" system of searchlight-aided interception has been described above. (See Part I, paragraphs 63-67.)

224. The following table shows the numbers of heavy and light A.A. guns and searchlights deployed on various dates, together with the approved scale on the outbreak of War:

	Heavy A.A.	Light A.A.	Searchlights
Scale approved before War	2,232	1,200	4,128
Outbreak of War	695	253	2,700
End of 1939	850	510	3,361
July, 1940	1,200	549	3,932
May, 1941	1,691	940	See below
December, 1941	1,960	1,197	

225. Although the approved scale of searchlight defence on the outbreak of War stood at 4,128, a total of 4,700 lights was recommended. Early in 1941 the figure of 4,532 lights actually deployed was reached, but subsequently the need for economy in manpower led to a reduction.

226. It was hoped that the introduction of the "U.P." A.A. rocket projector would do much to remedy the shortage of heavy A.A. guns, but the effective use of this weapon by A.A. Command was delayed by a number of factors, including shortages of ammunition. It was not until the crisis had passed, therefore, that they could be used for home defence in substantial numbers.

227. The total number of balloons authorized to fly and actually flying in the various barrages at the beginning of the period covered by this account was 1,958 and 1,741 respectively. In the Spring of 1941 it was 2,191 and 2,115. Subsequently a further expansion brought the number of balloons, actually flying at the end of 1941 up to 2,340—some 900 more than the total initial equipment of the barrages on the outbreak of War.

(g) *Expansion of the Raid Reporting Radar Organisation.*

228. In common with other forms of Home Defence, the Radar Chain of coastal stations of No. 60 (Signals) Group in my Command entered into a phase of intensive expansion to complete early warning radar cover to our Western sea approaches and also to face the problem of the enemy low-flying raiders. During 1941 the constructional programme involved nearly 100 radar stations—equivalent to setting up all the stations of several B.B.C.s within a period of a few months only. The War Cabinet had instructed that the highest priority should be accorded to this effort. The burden of this work fell heavily on the No. 60 Group

organisation. Short of technicians for installation, calibration, and maintenance duties, an acute shortage of the crews of radar operators to man the new stations also had to be faced. No. 60 Group nevertheless proved equal to the task, despite the fact that officers, airmen and airwomen in the Group were almost exclusively non-regular personnel of the R.A.F.V.R. without any previous service experience. 1941 was certainly the most hectic year of its existence.

229. The expansion of the Group and Sector organisation in my Command permitted a decentralisation of the radar reporting system. Originally all radar information had been reported to a Filter Room at Command Headquarters at Stanmore, the tracks of aircraft being passed on to the Operations Room. At the end of 1940 it was possible to decentralise the Stanmore Filter Room and split it between Fighter Groups throughout the country. This was also in accord with a decision to delegate the Air Raid Warning control from my Command Headquarters to the Headquarters of each Fighter Group. Owing to the heavy telecommunications re-arrangements involved, the complete decentralisation of radar reporting was not achieved until September, 1941.

230. Together with the great expansion of the radar chain and the decentralisation of the reporting system, there was an equivalent technical progress, not only with regard to equipment, but also in the handling and filtering of the radar information. The Operational Research Section of scientists at my Headquarters, working in conjunction with No. 60 Group, made many improvements to extract the maximum benefit from the available radar information. This application of the scientific method to the use of weapons through the medium of Operational Research Sections began first on problems within Fighter Command and subsequently spread throughout all Royal Air Force Commands.

(h) *Organisation to resist Invasion.*

231. Any account of the activities of the Command during this period would be incomplete without some mention of the preparations made to resist an invasion of the United Kingdom.

232. The roles to be played by the Home Commands in this eventuality had been laid down in broad terms by the Air Ministry in the Summer of 1940. It was then assumed that an invasion would fall into three distinct phases, beginning with a large-scale offensive against Fighter Command, continuing with an airborne invasion, and culminating in the seaborne invasion by which alone the Germans could hope to bring about our final defeat. It was thought that the third phase might in turn fall into three sub-phases, namely the preliminary concentration of shipping, the voyage across, and the attempt to establish a bridgehead. The Air Staff plan laid down the functions to be performed by the Command in each of these phases and sub-phases.

233. On consideration it seemed doubtful whether all these phases and sub-phases would be distinguishable in practice, and in devising arrangements to carry out the spirit of the plan, it was thought inadvisable to allot different roles to the squadrons during the voyage across on the one hand and the attempt to establish a bridgehead on the other. Instead, the various tasks which might devolve upon the fighter force in consequence of these activities by the enemy were grouped together in order of importance. Priority at this stage was given to the protection of our Naval forces against enemy bombers.

234. As experience grew, other modifications were made, and throughout the period it was necessary to keep constantly under review an elaborate complex of operational and administrative arrangements. It would be tedious to describe these arrangements in detail, more especially since, after the success of the Command during the preliminary phase of the German invasion plan in 1940, it never became necessary to repeat the experience or deal with subsequent phases.

235. One aspect of these preparations called, however, for something more concrete than planning. This was the defence of airfields against various forms of attack.

236. Before the War the necessity for providing for the local defence of our airfields against anything more than sabotage or low-level air attack had not been grasped. Consequently, when it was realised that airfields in this country might be seized by airborne troops or landing parties, measures had to be improvised.

237. The general defence of the country against enemy troops, whether airborne or seaborne, was, of course, the responsibility of the Army. On the other hand it had always been recognised as a principle in the Royal Air Force that Station Commanders were responsible for the local defence of their Stations. At the same time it was obviously essential that local defence schemes should fit into the general defence plan and be approved by the appropriate military Commander.

238. On the outbreak of War the resources of the Royal Air Force were insufficient to give adequate protection even against the dangers that were then foreseen, and help had to be obtained from the Army. Detachments of troops were supplied to undertake Station defence duties jointly with Royal Air Force personnel.

239. The consequence was a bewildering division of responsibility for defence against the various forms of attack that might be made; and it was quite clear that in many cases Station Commanders, who were answerable to their Group Commanders for the local defence of their Stations, would in practice be unable to exercise effective control over the miscellaneous units nominally at their disposal.

240. This problem was common to all Home Commands, but it was particularly urgent in Fighter Command, since fighter stations were a vital element in the defence system and some were peculiarly vulnerable by reason of their geographical position.

241. In the Spring of 1941 the experience of Crete focussed attention on this problem, which was already causing me grave anxiety, and various means of improving the situation were suggested. Few of these were of practical value, for although the necessity of securing the fighter bases was now generally recognised, the resources at my disposal were not adequate or suitably organised to effect the desired object.

242. It has already been pointed out that the local defences of Stations were manned partly by Army and partly by Royal Air Force personnel. This in itself was a source of weakness, particularly since there was a tendency for the Army detachments allotted to these duties to be changed at frequent intervals. The creation of a Royal Air Force defence force had begun in 1940, but towards the end of that year a halt was called to the scheme, pending a decision as to whether the War Office or the Air Ministry should ultimately bear the responsibility for defending the Stations.

243. To enable Station Commanders to dispose their resources to the best advantage, each was given the services of a Station Defence Officer. Many of the Officers appointed by the Air Ministry to fill these posts were past their first youth and lacked the resilience of mind and body required for service in the field.

244. There was a great need, in addition, for officers to be attached to the Staffs of the Fighter Groups for the purpose of inspecting Station defences and supervising training. After repeated requests, the services of one Army Officer at each Group were obtained; but the instructions given to these officers by the military authorities limited them, in effect, to the performance of liaison duties for which they were not needed.

245. Finally, there was in many cases a fundamental difference of view, which written orders seemed powerless to adjust, between Station Commanders and the Army Officers responsible for the general defence of their area, as to their respective duties and responsibilities in relation to their superiors and to each other.

246. There is no doubt that the problem was a difficult one, involving many issues which it lay outside the competence of a Commander-in-Chief to decide and on which even now no opinion can be properly expressed. The solution eventually adopted, which led to the formation of the R.A.F. Regiment, did not become effective until after the close of the

period with which this account is concerned. In the meantime the system of divided responsibility continued with all its evils. Consequently, despite much hard work at all levels, many Stations in my Command were far from impregnable throughout those months of 1941 when enemy landings by sea or air were at least a possibility.

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