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AIR OPERATIONS BY AIR DEFENCE OF GREAT BRITAIN AND FIGHTER COMMAND IN CONNECTION WITH THE GERMAN FLYING BOMB AND ROCKET OFFENSIVES, 1944—1945.

The following report was submitted to the Secretary of State for Air on 17th April, 1948, by Air Chief Marshal SIR RODERIC HILL, K.C.B., M.C., A.F.C., Air Marshal Commanding, Air Defence of Great Britain, Royal Air Force, from 15th November, 1943, to 15th October, 1944, and Air Officer Commanding-in-Chief, Fighter Command, Royal Air Force, from 15th October, 1944, until the end of the war in Europe.

PART I: PRELIMINARY

(a) Command and Higher Organisation of A.D.G.B. and Fighter Command.

1. Towards the close of 1943 the Allied fighter, tactical reconnaissance, and tactical bomber forces in the United Kingdom began to assemble under the command of Air Chief Marshal Sir Trafford Leigh-Mallory, K.C.B., D.S.O., in readiness for the landing in north-west Europe which was to take place in the spring. The name of the Allied Expeditionary Air Force was given to this combination, part of which was set aside, under my command, for the defence of the British Isles.

2. The Force that I commanded was functionally a successor to Fighter Command. For the time being, however, that name was abandoned, and the old name of Air Defence of Great Britain was revived.

3. I commanded Air Defence of Great Britain from its inception on 15th November, 1943, until 15th October, 1944, when the Allied Expeditionary Air Force was disbanded. My Command then became an independent one and the name Fighter Command was restored.

Thereafter, I held the post of Air Officer Commanding-in-Chief, Fighter Command, until the end of the war with Germany.

4. Throughout the life of Air Defence of Great Britain, and especially after the landings in Europe had begun, the control over my handling of operations which was exercised by Air Chief Marshal Leigh-Mallory in his capacity as Air Commander-in-Chief was little more than nominal. His energies were engrossed by offensive tasks. As the Armies in France pushed on, these tasks made it necessary for him to spend more and more of his time on the Continent. I was obliged, therefore, with the Air Commander-in-Chief's knowledge and consent, to deal directly with the Air Ministry, the British Chiefs of Staff, and governmental bodies on many points of operational policy. On the other hand, Air Chief Marshal Leigh-Mallory continued to exercise, through his staff, a close supervision over certain aspects of administration, especially those affecting personnel.

5. On 17th November, 1943, I received from Air Chief Marshal Leigh-Mallory a directive which defined the functions of my headquarters "under the general direction of the Air Commander-in-Chief" as follows:—

(a) To be responsible for the air defence of Great Britain and Northern Ireland.

(b) To command Nos. 9, 10, 11, 12, 13, 60 and 70 Groups and exercise operational control of fighters in Northern Ireland.

(c) To control operationally the activities of A.A. Command, the Royal Observer Corps, Balloon Command, "and other static

elements of air defence formerly controlled operationally by Fighter Command".

(d) To conduct "defensive and offensive operations which involve the use of squadrons of both A.D.G.B. and T.A.F. as heretofore under instructions issued to both headquarters until fresh instructions are issued".

(e) To develop air interception methods and apparatus for eventual use in A.D.G.B. and other theatres.

6. The reference in article (d) to offensive operations by squadrons of the Tactical Air Force was hardly more than a convenient fiction. Its purpose was not so much to place these operations under my control, as to prevent them from prematurely absorbing the energies of the Air Officer Commanding and staff of the Tactical Air Force, to the detriment of their more important task of preparing for the coming events in Europe. Although the operations were planned and their execution ordered from the headquarters of No. 11 Group, which was part of my command, they were supervised until the 15th March, 1944, by the Air Commander-in-Chief himself. Thereafter they were directed by the Air Marshal Commanding, Second Tactical Air Force (Air Marshal Sir Arthur Coningham, K.C.B., D.S.O., M.C., D.F.C., A.F.C.). This arrangement was typical of a series of complex relationships brought about by the special circumstances of the time. In effect it meant that the Air Officer Commanding, No. 11 Group (Air Vice-Marshal H. W. L. Saunders, C.B., C.B.E., M.C., D.F.C., M.M.), while he never ceased to be constitutionally my subordinate, acted for certain purposes as the agent first of Air Chief Marshal Leigh-Mallory and later of Air Marshal Coningham.

7. My real task, then, was that set out in articles (a), (b), (c) and (e) of the directive, and as much of article (d) as related to operations by formations under my own command. In short, it was primarily a defensive one. Although squadrons of A.D.G.B. were to play their part in operations over France during the assault phase of the European operations, the Overall Air Plan issued by the Air Commander-in-Chief showed that my most significant responsibility even in that phase would be to stand guard over the base. Obviously, we were approaching a stage at which the needs of the offensive must have priority. The directive of the 17th November emphasized the need for economy in defence "in order to make greater provision for offence", and called upon me to suggest changes in organisation with this need in mind. My problem, in fact, was to ensure, with limited resources, that the United Kingdom was securely defended from air attack as a base for the great operations by land, sea, and air which were being planned.

(b) *Resources Available.*

8. In the circumstances some "rolling up" of the Group and sector organisation seemed clearly justified. No. 14 Group, in the north of Scotland, had already been amalgamated with No. 13 Group before the time of my appointment. During the next few months I secured approval for further reductions. By 6th June, 1944 (D Day) the number of operational fighter Groups had been reduced to four and the number of active sectors from 10 to 14

—less than half the number in existence at the end of 1941. Still further reductions were made later.

9. Plans for translating the Air Commander-in-Chief's directive into practice were worked out by my staff and his in consultation. The basic strength of A.D.G.B. was fixed at ten day-fighter and eleven night-fighter squadrons. In addition six night-fighter squadrons earmarked for allotment to No. 85 Group—a Group formed for the purpose of defending the overseas base after the land forces should have advanced beyond the lodgment area—were to be put under my command for the time being. So long as I retained them I should be responsible for the night-fighter defence of the lodgment area as well as the United Kingdom and the waters between. Similarly, six day-fighter squadrons intended ultimately for No. 85 Group were to be put at my disposal to enable me to keep German reconnaissance aircraft at bay, and perform a number of other tasks arising directly out of the situation created by the coming assault. Finally, another fifteen day-fighter squadrons were to remain nominally in A.D.G.B., but be lent to the Second Tactical Air Force for the duration of the assault phase. Only in an emergency would these squadrons revert to my operational control before the end of that phase. It was agreed, however, that if a serious situation should arise, the Air Officer Commanding, No. 11 Group, would be justified in using any part of his uncommitted resources (other than American units) for the daylight defence of his Group area. A few aircraft of the Royal Navy would also operate under my control.

10. Thus, the maximum number of Royal Air Force, Dominion and Allied squadrons on which I was expected to call—including the fifteen squadrons lent to the Second Tactical Air Force—would be 48: rather less than half the number that had been considered necessary for the defence of the United Kingdom at the end of 1941, when the main theatre was in Russia.

11. However, since 1941 much progress had been made in the technique of fighter interception, especially at night. The German Air Force, on the contrary, was known to have lost a great deal of its hitting power since those days, and its offensive spirit had declined. Furthermore, great advances had been made in the technical methods and equipment on which the "static" elements of the air defence system relied. Against this I had to reckon with the psychological difficulty of maintaining the fighting spirit of men placed on the defensive while their opposite numbers were fighting an offensive battle. But despite this handicap, and despite the numerical limitations of the forces under my operational control, it was my opinion that the air defences would give a good account of themselves against any attack by orthodox weapons that the German Air Force might deliver.

(c) *Appreciation of the General Situation before the start of the German Flying Bomb Offensive.*

12. From the time of my appointment until the beginning of the flying-bomb offensive a

week after D Day, coming German air operations against the United Kingdom were expected to consist of attacks by both orthodox bombers and "secret weapons". The two kinds of attack might be delivered either at different times or, more probably, together.

13. Numerically the capabilities of the German bomber force could be judged with a fair degree of accuracy from our knowledge of its strength and disposition. To foresee how this potential hitting power would be used in practice was more difficult. For planning purposes we assumed that orthodox opposition to the landings in France might take the form of minor daylight attacks along the south coast before D Day, and attacks on the beaches and anchorages thereafter. Night attacks on a scale of 50 long-range-bomber sorties a night for two or three nights a week, increasing to 150 sorties a night for very short periods, seemed likely to occur during the weeks preceding D Day. Ports, concentration areas, and concentrations of shipping would be the most probable targets. Slightly heavier attacks would be possible if the enemy should decide to punctuate nights of maximum activity by comparatively long intervals of quiet.

14. Whether the German bomber force would operate on a major scale in daylight on D Day or the succeeding days was problematical. If it did, the enemy would doubtless choose the most favourable tactical conditions by attacking targets on his own side of the Channel.

15. All this was theoretical. But our estimates were based on practical experience. While our plans were going forward, the enemy came to our assistance by disclosing part of his hand. Early in 1944 the German bomber force delivered the series of night attacks on London and other towns which has been called the "baby Blitz". Thanks to the watch which we were able to keep on its movements, these attacks did not take us by surprise. The defences were ready. Although the Germans used their fastest bombers, which stayed over England only for brief periods, we were able to inflict a higher rate of casualties than the German night defences could inflict on our bomber forces during their long flights over Europe. Moreover, the navigation, target-marking, and bombing of the Germans when faced by our defences proved to be very poor. Thus the attacks were extraordinarily ineffective. After this experience, I felt confident that we should be able to deal with any attempt by the German bomber force to interfere with the concentration of the Anglo-American land, sea, and air forces in preparation for the assault.

16. The threat from "secret weapons" was harder to assess and more disturbing. By the autumn of 1943 a mass of information collected over a long period was beginning to convince even the most sceptical that the Germans were preparing novel means of air attack. When I took up my appointment in the early winter, few men in responsible positions doubted that those means included both a long-range rocket of some kind and also some form of flying missile, or pilotless aircraft. Evidence received a few weeks later made us virtually sure that certain new constructions in northern France,

which we called "ski sites"* were meant for the launching of missiles of the latter kind against this country.

PART II: THE FLYING BOMB CAMPAIGN.

(a) *Appreciation of the Threat up to "D" Day and Plans to meet it.*

17. Against a flying missile launched from the ground two methods of defence were possible. We might conduct a "defensive offensive" against the places where the missiles were made or stored, the constructions required for their launching, or the means of communication between those places. Some or all of these objectives might be attacked either separately or in combination, provided that we were able to locate them. Alternatively, or in addition, we might try to render the missiles harmless once they had been launched.

18. Early in December, 1943, the Chiefs of Staff decided to pursue the first method while exploring the possibilities of the second. Accordingly, on the 5th December the Second Tactical Air Force and the American Ninth Bomber Command began a series of bombing attacks on the "ski sites". The Strategic Air Forces, in the shape of our own Bomber Command and the American Eighth Bomber Command, also contributed their quota. By the end of the year, 3,216 tons of bombs had been dropped on the sites—about the weight that fell on London in an average fortnight during the night "Blitz" of 1940-41. So far as the Air Ministry could judge, the effect of these attacks was to "neutralize" twelve sites and seriously damage another nine. But since 88 "ski sites" had been located by this time, and the existence of another 50 was suspected, the neutralization of all the sites with the bombing resources that could be spared from other tasks seemed likely to prove a long-drawn business.

19. Meanwhile, early in December the Air Commander-in-Chief, at the instance of the Air Ministry, had instructed me to study the problem of defending the country against attack by pilotless aircraft and draw up plans accordingly. By way of assistance I was given an "appreciation" which embodied what was known at the time about the missiles that the Germans were getting ready to use against us. According to this document, these missiles flew at something between 250 and 420 m.p.h. and a height which might be anything from 500 to 7,000 feet. I was to assume that an attack by two missiles an hour from each of 100 sites might begin in February, 1944.

20. These estimates of speed and height were so broad as to make detailed planning difficult; but on 20th December, in reply to a questionnaire from my staff, the Air Ministry committed themselves, with reservations, to the opinion that the missiles would probably fly at an average speed of 400 m.p.h. and a height of 7,500 feet. Later these estimates were reduced to 350 m.p.h. and 7,000 feet, and still later to 330 m.p.h. and 6,000 feet. The views of the

* They were so called because on each site stood a number of buildings shaped like a ski laid on its side. The buildings seem to have been meant to provide blast-proof shelter for the missiles while they were being stored and serviced.

Chiefs of Staff as to when the attacks were likely to begin were also modified from time to time, as our bombing offensive against the "ski sites" got under way.

21. In devising measures to deal with pilotless aircraft, my staff and I worked in close touch with General Sir Frederick A. Pile, Bart., G.C.B., D.S.O., M.C., General Officer Commanding, Anti-Aircraft Command, and his staff, who helped in the preparation of all detailed plans which involved guns and searchlights as well as fighters.

22. It was clear at the outset that to prepare a detailed plan of defence would take several weeks. I therefore decided to submit a preliminary outline plan. I took as my point of departure the fundamental proposition that a pilotless aircraft was still an aircraft, and therefore vulnerable to the same basic methods of attack. Of course, as there was no crew, such an aircraft could not be made to crash by killing the pilot; on the other hand, it would be incapable of retreat or evasion, except, perhaps, to a very limited extent.* Nevertheless, if the missile should prove in practice as fast as was believed at first, the performance of the fighters on which we normally relied would be inadequate.

23. However, on balance, and considering the uncertainty of our knowledge, it would clearly have been unjustifiable to exclude any of the normal methods of defence which we were accustomed to use against piloted aircraft. Accordingly, I recommended in my outline plan, which I submitted to the Air Commander-in-Chief on the 16th December, that aircraft, guns, searchlights, and balloons all be deployed against pilotless aircraft in such a manner as to avoid causing mutual interference. I pointed out, however, that the missiles might well prove too fast for our fighters, and in any case would make difficult targets for A.A. gunners. I recommended, therefore, that the bombing offensive against the installations in France be continued with the utmost vigour. I also asked to be kept informed of the progress made by two committees which had been set up at the Air Ministry to investigate the possibility of radio and electro-magnetic counter-measures.†

24. During the second half of December General Pile and I completed our detailed plan on these lines. On the 2nd January I submitted the plan to the Air Commander-in-Chief, who approved it and submitted it in turn to higher authority. Meanwhile, the Allied bomber offensive against the "ski sites" was achieving good results and the likelihood of imminent attack seemed to be receding. On 22nd January the Chiefs of Staff came to the conclusion that the date by which we must be ready for attacks by pilotless aircraft to begin could safely be put back until the 1st

* At that time we believed that the missile could be made to turn in the air. In point of fact this effect was limited to the first few moments of flight, during which it had to be directed on to its calculated course by an adjustment of the automatic control mechanism made beforehand.

† Later it was established that the missiles were not controlled by radio. To divert them by means of an electro-magnetic field was theoretically possible, but would have needed so much copper and electric power that it was quite impracticable. Thus neither investigation produced any positive result.

March; later they postponed it still further, until the middle of the month. Since intensive preparations for the European operations were due to begin on the 1st April, we were thus faced with the possibility that the first use of pilotless aircraft by the Germans might coincide with these preparations; or even with the assault itself.

25. Hence, by the time the Chiefs of Staff came to examine the detailed plan it had been overtaken by events. Circumstances now called for a modified plan which would provide simultaneously for defence against pilotless aircraft and the needs of the offensive. Early in February the Chiefs of Staff asked that such a plan should be prepared. In the meantime, General Pile and I received authority to proceed with the administrative arrangements which would have to be made before any deployment on the lines laid down in the existing plan could be ordered.

26. During the next few weeks, therefore, we overhauled our plan and devised a modified version of it which aimed at meeting the threat from pilotless aircraft mainly with resources not directly required for the European operations. We called this modified version the "Concurrent Air Defence Plan for 'Overlord' and 'Diver'", or, more briefly, the "'Overlord'/'Diver' Plan"*. I submitted it to the Air Commander-in-Chief towards the end of February. After receiving his approval, it was approved in turn by the Supreme Commander and the Chiefs of Staff. On 4th March I gave instructions for copies of the plan to be sent to the Commands and Groups which would be directly concerned if it were ever put into effect.

27. With minor amendments, this was the plan on which we acted three months later, when the attacks began. Some account of it, and of its relationship to the earlier detailed plan out of which it grew, must therefore be given at this stage. Such an account may provide, perhaps, an insight into the conditions in which a major defensive operation of this kind has to be contrived. For in such cases a Commander must not only take into account a number of factors, political as well as military and logistic, which are governed by the capabilities of his own side; he must also reckon, first and last and all the time, with what the enemy may have up his sleeve.

28. Both the "Overlord/Diver" Plan and the earlier plan were based on the fundamental principles postulated for the first outline plan of the 16th December. But some of the assumptions which had been made when the original outline and detailed plans were made were modified by altered circumstances or fresh intelligence by the time the second plan was made. For example, as I have already pointed out, estimates of the performance of the weapon which we had to counter differed from time to time. Again, as the bombing offensive against the "ski sites" began to achieve its purpose, the Air Ministry revised their estimates of the probable scale of attack. But the broad concepts which determined the general nature of our defensive measures remained substantially unchanged.

* "Overlord" was the code-name for the European operations and "Diver" that for pilotless aircraft.

29. Much, therefore, remained common to both plans. Both plans, for example, relied on the ability of our existing radar chain stations to detect pilotless aircraft in the same way as they detected ordinary aircraft. After taking expert advice I had come to the conclusion that the stations would be able to do this, and that we should be able to tell pilotless from piloted aircraft by "track behaviour"—that is to say, the characteristics of their flight as interpreted by the radar responses. Similarly, members of the Royal Observer Corps would, presumably, be able to recognise pilotless aircraft by their appearance and the noise they made.* All that was required under this head, then, was to lay down a procedure for reporting pilotless aircraft by the means already in existence, and instruct all concerned in its use. For this both plans provided.

30. Again, at every stage the principal object that General Pile and I had in mind was the defence of London, which was the target threatened by the vast majority of the "ski sites". Secondly, we had to provide for the defence of Bristol, which was threatened by a smaller number of "ski sites" near Cherbourg. Thirdly, we had to bear in mind the possibility that, as a counter-measure to our preparations for the European operations, pilotless aircraft might be used against assembly areas on the south coast, and particularly round the Solent.

31. In each case, fighter aircraft were to be the first line of defence. For the defence of London the arrangement envisaged in both plans was that whenever an attack in daylight seemed imminent, fighters of No. 11 Group would patrol at 12,000 feet on three patrol lines, 20 miles off the coast between Beachy Head and Dover, over the coastline between Newhaven and Dover, and between Haywards Heath and Ashford respectively. Once an attack had begun, additional aircraft would patrol these lines at 6,000 feet. At night, fighters would patrol under the control of G.C.I., Type 16, and C.H.L. radar stations, and would be reinforced, if necessary, by further aircraft under Sector control.

32. At Bristol and the Solent the facts of geography promised a longer warning and more room to manoeuvre as well as a lighter scale of attack. Consequently I did not propose to fly standing patrols for the defence of those places. Should attacks appear imminent, however, fighters would be held ready to intercept by normal methods.

33. Under both plans, guns and searchlights would provide the next line of defence, and would, of course, become the first line of defence if at any time the state of the weather or any other factor prevented the fighters from operating. For the defence of London, General Pile and I proposed under the first plan to deploy 400 heavy A.A. guns in folds and hollows on the southern slopes of the North Downs, where their radar equipment would be liable to the minimum of interference from "jamming" by the enemy. We also proposed to use 346 light A.A. guns, to be deployed largely on searchlight sites, and 216 searchlights. In front of Bristol we proposed to put 96 heavy A.A. guns and 216 light A.A. guns,

with 132 searchlights. Thirty-two heavy A.A. guns, 242 light A.A. guns and a smaller number of searchlights would defend the Solent.

34. It was here that the most important differences between the two plans lay. The original plan called for the deployment of a grand total of 528 heavy and 804 light A.A. guns and more than 350 searchlights. Clearly, to muster as many guns and searchlights as this would not be easy. General Pile and I proposed to find half the required number of heavy A.A. guns from within Anti-Aircraft Command by depleting the defences of places not directly threatened by pilotless aircraft; the other half would have to come from the resources of 21 Army Group and Home Forces, and thus would consist very largely of guns already earmarked for the European operations. In the case of light A.A. guns and also of searchlights, 21 Army Group would have to provide an even higher proportion of the total.

35. Some risk would, of course, be involved in removing guns from places like Oxford, Birmingham, and the Clyde to defend London, Bristol, and the Solent against flying bombs. But the risk was one that I felt we should be justified in taking, since otherwise there was no possibility of finding the resources required for adequate defence against the threat from pilotless aircraft as we conceived it in December, when the plan was made.

36. By February, when we came to draw up the revised plan, the position had changed. Virtually every gun and searchlight that could be spared would shortly be needed for the European operations; and it was essential that the "Diver" defences should make the smallest inroad on the "Overlord" resources that was compatible with an adequate scale of defence. Fortunately, the success of the bombing attacks on the "ski sites" held out the hope of achieving an adequate scale of defence on cheaper terms than had seemed possible two months earlier.

37. Accordingly, General Pile and I carefully reviewed this part of our original plan. We came to the conclusion that substantial savings in both guns and searchlights could and must be made. We therefore proposed to reduce the number of heavy A.A. guns to be deployed on each of the sites in the belt defending London from eight to four. This would save 208 guns. We hoped that by the time the attacks began 128 American 90 mm. guns, using electrical predictors and a new type of radar called S.C.R.584, might be available to replace a corresponding number of our 3.7-inch guns with their mechanical predictors and G.L. Mark III radar; for there was every indication that the S.C.R.584 and electrical predictors would be particularly effective against pilotless aircraft. But as this equipment had yet to arrive from the United States and crews be trained in its use, we dared not count on it: we therefore prepared alternative plans to cover either contingency. We also proposed to reduce the number of light A.A. guns in front of London from 346 to 246.

38. No reduction in the number of heavy A.A. guns defending Bristol seemed possible, and we decided to leave this figure at 96. In view of the great need of light A.A. guns for "Overlord" we proposed, however, to reduce

* All these assumptions proved correct.

the strength of these from 216 to 36. We also proposed to do without searchlights in this area, other than those provided by the normal layout. Under the revised plan, all the Bristol guns, both heavy and light, would have to be withdrawn by "D" Day; but we hoped that by that date the threat to that city, never very serious, would have been neutralized by bombing.

39. As for the Solent, fortunately that area would, in any case, be heavily defended against orthodox air attack during the final stages of preparation for "Overlord". In these circumstances no special "Diver" deployment would be needed there, apart from a few searchlights. We visualized, however, a possible re-disposition of the "Overlord" guns to fit them for a dual role. Here, again, there would be a substantial saving.

40. Under the original plan, balloons would provide a third line of defence for London. For this purpose I had originally proposed to put a permanent* barrage of 480 balloons immediately behind the guns on the high ground between Cobham (Kent) in the east and Limsfield in the west. It so happened that I was already seeking authority from the Chiefs of Staff to reduce the balloon defences of the country by 500 balloons: by appropriating this saving to defence against pilotless aircraft the problem of providing the "Diver" barrage could be solved. As these balloons were not needed for "Overlord" there was no need to alter these proposals in the revised plan.

41. It was, then, with the revised plan ready for action that we awaited the beginning of the German attacks. To say that this plan represented a compromise between the requirements of "Overlord" and those of "Diver" would not be strictly true; for the defence of the base against "Diver" was itself an essential "Overlord" requirement. But it provided at once the largest appropriation that could be spared for the job, and the smallest that was likely to be effective against the threat which was then foreseen. The number of guns to be deployed, in particular, was no more than a bare minimum. In the circumstances it was impossible for us to budget for more guns; but we took care to frame the plan in such a way that the numbers could easily be increased if further guns should happen to become available. I also took the precaution of pointing out that if the pilotless aircraft should fly between 2,000 and 3,000 feet instead of at the greater altitude expected by the Air Ministry, the guns would have a very awkward task, for between those heights the targets would be too high for the light anti-aircraft guns and too low for the mobile heavy guns which at that time could not be traversed smoothly enough to engage such speedy missiles.

42. In the event, the threat which materialised in the summer was to prove a very different one from that foreseen in February when the plan was made. This was not only because the height at which the pilotless aircraft flew had been over-estimated, but also because the forecasts of the enemy's capabilities with which the Air Ministry provided us were based on

* At that stage lack of communications and manning difficulties were expected to make the usual system of control impracticable

knowledge which was incomplete in one important respect. Consequently, when the attack developed we soon found that we needed not only more than the 288 heavy and 282 light A.A. guns postulated in the revised plan, but more than the 528 and 804 respectively for which we had budgetted in our original, superseded plan.*

(b) *The Eve of the Attacks*

43. Ironically enough, the emergence of this undiscovered factor which upset our calculations was due to the very success with which we had bombed and neutralized the "ski sites". By the end of April most of the sites had been rendered unfit for use. Although the Germans repaired some of them, from that time onwards there were never at any time more than ten "ski sites" in a state to fire.

44. Fortunately for them, the Germans soon realised how vulnerable the "ski sites" were, and began to build other launching sites which were more carefully hidden and harder to destroy. By simplifying the plan of construction and using pre-fabricated parts, they were able to complete these new sites very quickly.

45. Since the armistice the Germans have told us that they began this new programme of construction in March 1944. However, it was not until the 27th April that the first of the "modified sites", as we called them, was seen on a reconnaissance photograph. By the middle of May twenty such sites had been located, and by the 12th June the number had risen to 66. Forty-two were aligned on London and the rest on Bristol or south-coast ports.

46. The "modified sites" made difficult bombing targets. When Typhoon bombers carried out an experimental attack on one of them on the 27th May the site proved hard to find and the results were poor. Besides being small and well concealed, the sites comprised few buildings at which bombs could be aimed. Unlike the "ski sites", they seemed to be intended as launching points and nothing more. The conclusion was that any stocks of pilotless aircraft held locally would not be kept on the sites themselves, but stored elsewhere or dispersed in the wooded country amongst which all the sites were placed.

47. At least partly for these reasons, we made no further attacks on the "modified sites" until after the Germans had begun to launch missiles from them. Meanwhile, the officers at the Air Ministry and elsewhere who were responsible for offensive counter-measures were debating whether to attack certain other constructions, usually referred to as "supply sites". They believed that these constructions had something to do with the storage or maintenance of pilotless aircraft; but they were not sure. Nevertheless, two attacks on one of the sites were made about the end of May. From that time onwards, little was done to hinder the enemy's final preparations for the offensive.

48. This state of affairs was a natural consequence of the awkwardness of the "modified sites" as bombing targets, and our uncertain

* The weapons actually deployed in the middle of August, 1944, when the campaign was in full swing, comprised 800 H.A.A. and 1,100 40 mm. L.A.A. guns, over 700 rocket barrels, and some 600 light guns (mostly 20 mm.) manned by the R.A.F. Regiment and the Royal Armoured Corps.

knowledge of the enemy's plans. I believe, however, that aligned with these causes was a psychological factor. It must be remembered that for many months past the chief threat had seemed to come from the "ski sites". The use of our bomber forces against the "ski sites" had therefore been felt as a necessary, but still an unwelcome, diversion of effort at a time when interest was focussed on the coming European operations. To the officers responsible for directing offensive operations the success of the attacks on the "ski sites" must have come as a great relief. In the circumstances, they would have been hardly human if they had not been more reluctant than perhaps they realised to recognise that the neutralization of the "ski sites" had not averted the menace after all.

49. I think, therefore, that at the end of May and in the first half of June the threat from the "modified sites" was under-estimated, not in the sense of a failure to apprehend it intellectually, but in the sense that it was not felt as keenly as the original threat from the "ski sites" six months earlier. If it had been, I do not doubt that the "modified sites" would have been attacked as vigorously then—despite their shortcomings as targets—as they were a few weeks later, when "Diver" had begun.

50. Whether this would have had much effect on the subsequent course of events is another matter. The question is one to which no final answer is possible. My own opinion is that a well co-ordinated series of attacks on the "modified sites" during the weeks immediately preceding the "Diver" campaign would have been worth making, but that nothing short of the destruction of all the sites would have prevented the Germans from using their new weapon sooner or later. Nor does my belief that the menace of the "modified sites" was under-estimated necessarily imply that I think the omission to attack the sites was wrong in the light of the knowledge available at the time. Even if their dangerousness had been fully realised, there would still have been strong arguments against attacking them. And while it is easy to be wise after the event, at the time there was no means of knowing how imminent the danger was. On the contrary, until some 36 hours before the first pilotless aircraft was launched, such intelligence as was available suggested that the "modified sites" were not likely to be used for several weeks.*

51. The fact remains that during the first half of June the Germans were able to press on with their preparations to bombard us with pilotless aircraft, virtually unmolested by our bomber forces.

52. At that stage, one of the tasks of my Command was to prevent German reconnaissance aircraft from approaching the areas where our forces were concentrating. In this we succeeded even beyond our expectations. Partly

* On the 11th June, however, the Air Ministry received a report which stated that a train loaded with missiles had passed westwards through Belgium two days earlier. On the same day photographic reconnaissance revealed unusual activity at six of the "modified sites". This information did not reach my headquarters until after the German offensive had begun; but little or nothing would have been gained if I had received it earlier, for the defence plan had been ready since March, and I should not have ordered deployment merely on the strength of these two reports.

on this account, the landings in Normandy early on the 6th June achieved complete tactical surprise. Even on subsequent days, when the Germans had had time to appreciate what we were doing, air opposition was far from energetic. Naturally enough, the Air Commander-in-Chief and his staff were jubilant, and had little time or inclination to think of pilotless aircraft.

53. It was equally natural that my staff and I, with our defensive preoccupations, should not entirely share this optimism. It seemed to us that things were going almost too well. So much was at stake for the enemy that we dared not believe he would let us have everything our own way. We could not help suspecting that he still had something up his sleeve.

(c) *The Attacks: First Phase (13th June to 15th July).*

54. Events were soon to substantiate our doubts. Shortly after midnight on the night of the 12th-13th June the German long-range guns opened fire across the Channel. In this there was nothing novel; what was unusual was that for the first and last time during the war, a town some miles from the coast was shelled. Eight rounds fell at Maidstone, one at Otham, two-and-a-half miles to the south-east, and twenty-four at Folkestone. The bombardment doubtless achieved its purpose, inasmuch as it gave some people the impression that a novel weapon was being used and tended to create an atmosphere of uncertainty and rumour. At least one Me.410 flew over the London area during this phase and was shot down by anti-aircraft fire near Barking.

55. At 0400 hours the shelling stopped. A few minutes later an observer on duty at a Royal Observer Corps post in Kent was passed by an aircraft which made "a swishing sound" and emitted a bright glow from the rear. In common with all his colleagues, he had been briefed to recognise pilotless aircraft; and in accordance with his instructions he shouted "Diver". The missile continued over the North Downs "making a noise like a model-T Ford going up a hill" and fell to earth with a loud explosion at Swanscombe, near Gravesend, at 0418 hours. During the next hour three more of the missiles came down at Cuckfield, Bethnal Green, and Platt (near Sevenoaks) respectively. No casualties were suffered except at Bethnal Green, where six people were killed and nine injured; in addition a railway bridge was demolished.

56. The attack then ceased for the time being. I came to the conclusion that so small an effort did not justify the major re-disposition of the anti-aircraft defences required by the "Overlord-Diver" Plan. The Chiefs of Staff agreed. I therefore gave orders that the plan was not to be put into effect until we could see more clearly what was going to happen. In the meantime the existing defences were authorised to engage pilotless aircraft on the same terms as ordinary aircraft. I had already arranged that a visual reconnaissance of the most likely launching areas should be flown; and at the instance of the Air Ministry several attacks were made on three of the so-called "supply sites" on the 13th, 14th and 15th June. These absorbed the whole of the bombing effort that could be spared from other

tasks. Accordingly the "modified sites" still went unmolested, although it is now known, and was strongly suspected at the time, that the missiles had been launched from sites of this class.

57. At 2230 hours on the 15th June the attacks were resumed on a much heavier scale. During the next twenty-four hours the Germans launched over 200 pilotless aircraft—or, as we soon began to call them, flying bombs or "doodle bugs"—of which 144 crossed the coasts of Kent and Sussex and 73 reached Greater London. Thirty-three bombs were brought down by the defences, but eleven of these came down in the built-up area of Greater London.*

58. Clearly we were confronted on the morning of the 16th June by a situation very different from that of the 13th. I was of the opinion that the time to execute the "Overlord-Diver" Plan had now come; and in the course of the day the Chiefs of Staff agreed that this should be done. That afternoon I attended a "Staff Conference" over which the Prime Minister and Minister of Defence presided. One of the decisions then reached was that, in consultation with General Pile, I should re-distribute the gun, searchlight, and balloon defences "as necessary to counter the attacks". Another was that for the time being the guns inside the London area (as well as those outside) should continue to engage flying bombs. We abandoned this arrangement two days later, after experience had cast doubt on the assumption that most of the bombs that were hit exploded in the air.

59. Before going to the conference I had given orders for deployment of the "Diver" defences to begin. By the early hours of the 17th June the first A.A. regiment to move had taken up its new positions and the deployment of the balloon barrage had also begun. When drawing up the plan we had calculated that deployment would take eighteen days to complete and that it would be wiser to allow twenty-five days; the Air Ministry had expected to be able to give us a month's warning. In the event we had received no warning at all, apart from that provided by the Germans themselves on the 13th June. In the circumstances it was imperative that we should get the job done quickly. The original time-table went by the board. Thanks to the administrative arrangements which had already been made and to remarkable feats by both Anti-Aircraft Command and Balloon Command, the whole of the planned deployment was virtually complete by the 21st June, only five days after the issue of the order to deploy.

60. All this time the attacks were continuing at the rate of about 100 flying bombs a day. Our fighters were bringing down about thirty per cent. of the bombs and the static defences some eight to ten per cent.; but more than half the bombs which crossed the coast were getting through to Greater London. I soon

realised that a scale of static defence which might have been adequate against such attacks as eight or ten "ski sites" could have delivered was not going to suffice against the effort of which the "modified sites" were showing themselves capable. In consultation with General Pile, therefore, I arranged for the gun defences to be substantially reinforced. By mid-day on the 28th June 363 heavy and 522 light A.A. guns were in action. Further weapons, including light guns manned by the Royal Air Force Regiment, anti-aircraft tanks of the Royal Armoured Corps, and rocket projectors, were either in position or on the way. I also arranged for the strength of the balloon barrage to be doubled.

61. Meanwhile Tempest V, Spitfire XIV, Spitfire XII, Spitfire IX, Typhoon, and at night Mosquito aircraft of No. 11 Group had been in action against flying bombs since the beginning of the main attack. As we have seen, their rate of success at this stage amounted to about thirty per cent. of all the bombs which crossed or approached the coast. On the 16th June I had issued orders defining their area of patrol as the Channel and the land between the coast and the southern limit of the gun-belt, and prohibiting them from passing over the gun-belt except when actually pursuing a flying bomb. I soon found that in good weather the fighters were much more successful than the guns, which were badly hampered by the fact that the flying bombs did not fly at the height of 6,000 or 7,000 feet previously estimated by the Air Ministry, but at that very height of 2,000 to 3,000 feet which we had always realised would make the gunner's task most difficult.* On the other hand, when the weather was bad, poor visibility hampered the fighters, and in these conditions the guns were likely to prove the more effective weapon. Accordingly, I arranged on the 19th June that in very good weather the guns should abstain from firing in order to give the fighters complete freedom of action. Conversely, when the weather was bad, the guns would have freedom of action and no fighters would be used. In middling weather fighters would operate in front of the gun belt and enter it only when pursuing a flying bomb. When a fighter entered the gun belt for this purpose the guns would, of course, withhold their fire; otherwise the guns inside the belt would be free to fire up to 8,000 feet. Outside the gun belt gunfire was prohibited in these circumstances, except that light A.A. gunners linked to the communications network might open fire on targets they could see, provided no fighters were about.

62. These rules for engagement, which I ordered to be codified and issued to those concerned on the 26th June, were intended to prevent mutual interference between guns and fighters. For reasons which I shall explain later, they did not altogether achieve this aim. But before coming to this question it will be appropriate to review the progress of the German attacks and of our counter-measures up to the date in the middle of July when the question of an important change in our defence plan came to a head.

* Originally the Germans meant the bombs to fly higher, doubtless so as to minimize the effect of light A.A. fire. This proved impracticable, and without the knowledge of the Air Ministry they changed their plans.

* The figures were :

	Brought down outside London	Brought down inside London
By fighters alone	7	—
By guns alone	14	11
By fighters and guns jointly	1	—
Totals	22	11

63. The scale of attack for the first two weeks was, as I have said, of the order of 100 bombs a day. After a period of deliberation at the outset, the authorities responsible for offensive counter-measures embarked on a series of bombing attacks on the "modified sites". A number of sites were neutralized, but the number remaining was always sufficient to have launched a scale of attack several times greater than that which we actually experienced. In other words, the factor limiting the German effort was not the number of sites available, but something else—most probably the rate at which the flying bombs could be supplied to the sites. It was therefore arguable that the attacks on the "modified sites" amounted to locking the stable door after the horse had been stolen, and were a waste of effort. The authorities decided to continue the attacks, however, in order to harass the launching crews and thereby reduce their efficiency. I cannot say how far that object was achieved, since my staff were never able to establish any statistical relationship between the bombing attacks on the "modified sites" and the rate or quality of the enemy's fire. The Germans have told us since the armistice, however, that the bombing of the "modified sites" made little difference to them.

64. At the same time the authorities responsible for offensive counter-measures appreciated that the factor limiting the scale of attack was probably supply. Information from intelligence sources cast increasing doubt on the relevance of the so-called "supply sites" and showed that the key-positions were probably certain underground storage depots situated in limestone quarries in the valley of the Oise and an abandoned railway tunnel in Champagne. Successful bombing attacks were made on several of these depots, and in two instances were followed by a noticeable decline in the scale of attack. In both cases, however, the effect was only temporary. Apparently the Germans were able to improvise other channels of supply. Hence, while I was much relieved by the offensive counter-measures undertaken by the Tactical and Strategic Air Forces, I realised that they were not likely to put a stop to the German attacks. The loss or preservation of thousands of lives, much valuable property, and a substantial productive capacity, would turn on our ability to provide an effective system of defence for London with the resources under my operational control. At that time our land forces in France had not advanced beyond the lodgment area: the capture of the launching sites in the imminent future seemed very doubtful. The flying-bomb attacks might well go on for many months.

65. And in fact the attacks continued at the same rate of roughly 100 flying bombs a day until the end of the first week in July, when the effort fell for about ten days to an average of less than 70 a day. This decline may have been partly due to good weather, for the Germans usually saved their biggest efforts for days when the weather was likely to hamper the defences. But I incline to the view that it was largely the result of a specially successful attack on one of the main storage depots which was made by Bomber Command on the night of the 7th July. Except during this same second week in July, when both good weather and a reduced scale of attack helped our

fighters to shoot down a higher proportion of the bombs than usual, about half the bombs that crossed the English coast went on reaching Greater London. In sum, during the five weeks which ended at sunrise on the 15th July, just under 3,000 flying bombs came within the compass of the defensive system.* Our fighters shot down rather more than a tenth of them into the sea, and a few were brought down into the sea by A.A. fire or fell into it of their own accord. Of the remaining 2,500 odd which crossed the coast, fighters, guns, and balloons respectively destroyed or brought down about half over the land, fighters claiming ten and guns four casualties to every one claimed by the balloon defences.

66. Outwardly these results were not too bad. Nevertheless, I was far from satisfied that the defences were working properly. In the first place, an average of 25 bombs a day was still reaching Greater London. The overall average since the beginning of the attacks amounted to nearly 40 bombs a day. London had endured heavier bombing than this in 1940; but for various reasons an intermittent drizzle of malignant robots seemed harder to bear than the storm and thunder of the "Blitz". Nor were the material results of the bombardment inconsiderable. Between the 13th June and the 15th July it killed about 3,000 people, seriously injured 10,000, and irreparably damaged 13,000 houses. Although no objectives of vital importance to the war effort were hit, many public buildings such as churches, hospitals, and schools appeared in the casualty list.

67. Secondly, although the performance of the defences as a whole had improved continuously since the beginning of the attack, and although the fighters had done particularly well during the last two weeks, I saw many signs that the limit of improvement with our existing methods had been reached. I was reluctantly convinced that unless some radical change was made, the future was more likely to bring a slow decline than further progress.

68. The circumstances which led me to this view can only be understood by reference to the special problems of the various arms of the defence. In order to gain an intimate knowledge of those problems I had decided early in the attack to share in the fighter operations as a pilot, using various aircraft in turn. Personal experience convinced me that the first problem confronting the fighters was the speed of the bombs, which was rather greater than we had expected before the attacks began. † The fastest aircraft I had were a wing of Tempest Vs and a wing of Spitfire XIVs. These could not be everywhere at once. One of my first moves, therefore, was to obtain the Air Commander-in-Chief's consent to my borrowing at first a flight and later a wing of Mustang IIIs from the Second Tactical Air Force. These aircraft were very fast at the height at which the bombs flew and made a valuable contribution

* This figure does not include "abortive" bombs which fell in France or into the sea on the French side of the Channel. It seems that the Germans launched five flying bombs for every four that came within the compass of the defences.

† Most of the bombs seem to have left the launching sites at about 200 m.p.h. Their speed increased throughout their flight, reaching about 340 m.p.h. at the English coast and 400 m.p.h. or thereabouts over London.

to the improved results achieved by the fighters after the first week in July. By the 15th July I was using a total of thirteen single-engined and nine twin-engined (Mosquito) squadrons against flying bombs. Six of the Mosquito squadrons alternated between this work and operations over the lodgment area, two of them doing bomber-support work as well. I found that, while some pilots took readily to the work of shooting down flying bombs, the majority preferred shooting down enemy aircraft over France. To instil enthusiasm for the novel and impersonal business of shooting at pilotless missiles, and ensure that pilots were not kept long enough at the task to make them stale, was not the least of my anxieties.

69. In order to get as much speed as possible, I arranged that aircraft which were to be used exclusively against flying bombs should be stripped of their armour and all unnecessary external fittings, and that their paint should be removed and their outer surfaces polished. The engines were modified to use 150-octane fuel and accept a higher boost than usual. In this way we managed to increase the speed of some of the single-engined fighters by as much as 30 m.p.h.

70. Even with these modifications the fighters had only a small margin of speed over the flying bombs. Nevertheless they did have a margin. It was reported that a demonstration by a German pilot with a captured Spitfire had convinced Hitler that our fighters could not catch the flying bomb. This was true of the Spitfire V, and almost true of the Spitfire IX; but it was not true of the Spitfire XIV or the Tempest. Even so, these aircraft had no more than a fractional superiority. Hence the problem was essentially one of time and space. For interception over the sea we used a method of close control from radar stations on the coast, or alternatively a method of running commentary. At best the radar chain could give about six minutes' warning before the flying bombs reached the coast; but in practice the time available to the fighters over the sea was always less than this, not only because of inevitable time-lags but because we dared not risk our modified aircraft on the far side of the Channel, where they might be surprised by German fighters. Later the Royal Navy were to come to our assistance by providing a chain of small craft which operated at three mile intervals seven miles off the French coast, carrying observers who warned our pilots by means of signal rockets and star-shells that flying bombs were on their way. This improvised system was in the final stages of development about the time when the main attack came to a close.

71. Over the land we used the method of running commentary from radar stations and Royal Observer Corps Centres, supplemented by various devices such as signal rockets, shell-bursts, and searchlight beams, for indicating the approach of flying bombs to patrolling pilots. The weakness of this method was that sometimes several pilots would go after the same flying bomb, leaving other bombs to slip through unmolested. However, there was nothing else we could do, for the absence of low-looking radar made close control over the land impracticable.

72. The majority of the flying bombs crossed the coast between Cuckmere Haven and St. Margaret's Bay. The distance thence to the southern edge of the gun belt was in most places about 30 miles. The flying bombs covered this distance in five minutes. Five minutes, then, was the time available to the pilot of an overland fighter to select his target, get within range of it, and shoot it down, unless gunfire had been restricted or he took advantage of the rule which allowed him to enter the belt in pursuit of his quarry. In this case he would have an extra minute or so before he reached the balloon barrage. Thus there was rarely time for a stern chase unless the pursuer started with a substantial advantage in height. On the whole the most effective procedure was to fly on roughly the same course as an approaching bomb, allow it to draw level, and fire deflection shots as it passed, being careful not to fire when it was closer than 200 yards lest it should explode in the air and blow up the attacker.* The hot gases emitted by a bomb immediately in front of the fighter made a steady aim difficult, so that short bursts and frequent aiming corrections were required. Usually several bursts were needed to inflict enough damage to explode the bomb or bring it down. Another method useful on occasions but hardly suitable for general adoption, was to get close beside the target and tip it over by inserting the wing of the fighter underneath that of the bomb and then raising it sharply.

73. Thus, in many respects the fighters had a stiff task. That which faced the guns was, if anything, more awkward still. Theoretically, pilotless aircraft ought to have made ideal targets for anti-aircraft artillery, since they flew on courses which could be accurately predicted from the data on which the technical devices normally employed had been designed to work. For the first time in the war, the gunners were presented with targets that could not dodge. In practice this advantage was outweighed by the speed of the missiles and the critical height at which they flew. They were too high and went too fast to make good targets for light A.A. guns, but were too low and crossed the field of vision of the heavy A.A. gunners too swiftly to give adequate time for the radar and predictors to be used and the guns be laid by hand. These difficulties could be minimised so far as the heavy guns were concerned by replacing the mobile guns used in the original "Diver" deployment by static guns which could be electrically elevated and traversed and were fitted with improved fuse setters and other devices which made them quicker to operate and more accurate. Unfortunately the static guns required concrete emplacements which took some time to instal. A steel mattress, known as the "Pile Mattress," which was devised by the R.E.M.E. detachment at Anti-Aircraft Command provided a way out of the difficulty; and the task of replacing the mobile guns by static guns was started towards the end of June.

* During the first six weeks of the attacks alone, eighteen fighters were substantially damaged and five pilots and one Navigator/Radio Operator killed in this way. Even though the flying bomb could not hit back deliberately, "Diver" patrols were by no means unattended by risk.

74. Another change which General Pile found necessary at an early stage was the removal to higher ground of the radar sets belonging to the heavy guns. At the start these were placed in hollows because the "Overlord/Diver" Plan had been made in anticipation of attempts at "jamming" by the enemy. Successful bombing attacks during the "Overlord" preparations had, however, virtually deprived the Germans of this resource, and so it was possible to move the sets to more exposed positions in which the contours of the ground caused less interference.

75. Another variation from the plan concerned the light guns. Originally these were to have been deployed on searchlight sites, but after the attacks had begun, General Pile came to the conclusion that better results would be achieved by concentrating them in front of the heavy gun belt. He also found that by linking troops of four guns each to a heavy-gun predictor and G.L. radar set he could use the light A.A. guns against "unseen" as well as "visual" targets.

76. Towards the end of June we began to receive the S.C.R. 584 radar sets and improved predictors which we had been eagerly expecting since February. These two items of equipment were destined to contribute very largely to the ultimate success of the guns. An intensive training programme which had to be organised with such resources as could be spared from operations was, however, indispensable before they could be used on any considerable scale.

77. With the balloon barrage the problem was largely the arithmetical one of achieving a sufficient density to give a reasonable chance of success. We found, however, that in practice the theoretically computed rate of success was not always attained: somehow more bombs slipped through the barrage than should have done so according to the laws of probability, if our assumptions were correct. One difficulty was that the "double parachute links"* used to arm the balloon cables in normal barrages had not been designed to cope with aircraft travelling much faster than 300 m.p.h. For this reason we did not arm the cables of the balloons deployed during the first few days of the attack. But we soon came to the conclusion that an imperfect arming device was better than none; and by the 21st June all cables were armed. I received a large number of suggestions for increasing the effectiveness of the barrage in other ways, such as by adding "whiskers", nets, kites, and other forms of drapery. Many devices of this kind were tried, and some were of value, but as most of them increased the physical difficulty of handling the balloons in one way or another, I had to adopt a somewhat cautious attitude lest the best should prove the enemy of the good.

78. A slight re-disposition of the barrage proved necessary in order to prevent bombs which penetrated to its northern edge from being brought down in built-up areas. The notion

* The "double parachute link" was a device whereby, as soon as a balloon cable was struck, it was automatically severed near the top and bottom, so that the aircraft which struck it carried away the central portion. Parachutes then opened at each end of this portion and exercised a drag intended to make the aircraft stall.

of keeping the balloons up in all weathers—which was contained in the original "Overlord/Diver" Plan but afterwards abandoned—was considered a second time after the attack had begun, but once more found impracticable. We therefore used a system of control which was less flexible than that used for normal barrages, but served its purpose adequately. In order that our pilots should not lose their lives by colliding with the barrage we perpetrated a pious fraud on them by allowing them to believe that the balloons would fly continuously.

79. So much for the problems that confronted the individual arms of the defence and the chief measures taken to solve them. There were, of course, many smaller problems with which I have not space to deal. But the biggest problem of all was not confined to one arm: it was of wider consequence and consisted in securing the right kind and degree of co-operation between guns and fighters. Since in a sense these were rival weapons, the task had always been a troublesome one from the early days of the war; nevertheless, so far as operations against orthodox aircraft were concerned, with experience a satisfactory working solution had been found. During the "Baby Blitz," for example, the co-operation between guns and fighters had been most satisfactory. I found, on the other hand, that as the Germans must have intended, the novel problem presented by the flying bomb created a host of new difficulties. For example, it was sometimes hard for a pilot to realise that he was approaching the gun belt in time to avoid infringing the rule against entering it. Conversely, gunners in the belt who were engaging a flying bomb did not always realise in time that a pilot was legitimately entering the belt in pursuit of this or another missile, and would go on firing to the peril of the pilot's life. The crews of the guns on the coast and elsewhere outside the gun-belt were in a still more difficult position, for except in bad weather they always bore the onus of ensuring that no fighters were about before they could open fire. In the excitement of the moment, when the attention of the gunners was concentrated on their targets, it was only too easy for a fighter travelling at six miles a minute to slip unnoticed into the field of fire. Consequently numerous infringements of the gun-belt by fighters, and many unintentional engagements of our fighters by the guns, were reported, especially in middling weather when guns and fighters were simultaneously in operation. Charges and counter-charges mounted; and with deep misgiving I began to sense a rising feeling of mutual distrust between pilots and gunners.

80. I felt very strongly that this state of affairs could not be allowed to continue. If the causes of friction were not removed, the situation would inevitably grow worse. As the first four weeks of the attack went by, the overall achievement of the defences improved. To all appearances, the machine was growing more efficient. But this improvement brought me scanty satisfaction. I knew that the point would soon be reached at which this friction would become the limiting factor, and no further improvement would be possible. Looking further ahead, I realised that, whatever temporary advantages our existing practice might bring, we could not afford to sacrifice the spirit

of co-operation between gunners and pilots which had been steadily built up in the past.

81. I came to the conclusion that the only solution was to give guns and fighters freedom each in their own sphere. On the 10th July, therefore, I decided to prohibit fighters from entering the gun-belt, whatever the circumstances, after the 17th July. At a conference held to discuss this change, General Pile pointed out that an obvious corollary to it was to move all the guns inside the belt, so as to have them all in one place and provide both guns and fighters with clearly-defined spheres of operation. The logic of this argument was irrefutable; and I agreed to examine detailed proposals for moving all the guns into the belt except a few which would remain on the coast to act as "markers".

82. The great advantage of the principle of separate spheres of operation for guns and fighters was that it would lessen the chances of misunderstanding by creating a clear-cut situation. It would also ease the task of the gunners by giving them a free hand in their own territory. Not the least important point was that when not in action they would always be free to train, whereas under the existing arrangements when gunfire was restricted and fighters were operating they were condemned by the presence of our aircraft to an enervating inaction. At the same time the change would reduce the field of action open to the fighters. In order that the necessity for making this sacrifice might be clear to pilots, I instructed my Deputy Senior Air Staff Officer, Air Commodore G. H. Ambler, C.B.E., A.F.C., to prepare an explanation which could be circulated to lower formations. At this stage no question of changing the geographical position of the gun-belt had been raised.

(d) *The Re-deployment of the Guns (mid-July).*

83. Nevertheless, there were strong arguments in favour of such a move. Originally we had deployed the guns on the North Downs largely because the "Overlord/Diver" Plan had been drawn up at a time when jamming of our radar by the Germans was a threat which could not be neglected. The desire to reduce this threat or minimise its effects if carried out had done much to dictate this choice of situation. Now, as we have seen, by D-Day successful bombing of German wireless and radar stations had virtually removed the possibility of jamming. This fact and its significance had not become fully apparent until after deployment had begun.* Consequently we had carried out the deployment as planned, though shortly afterwards, as already related, General Pile had taken advantage of the absence of jamming to move some of the heavy-gun radar sets to better and more exposed positions within the original deployment area.

84. By the middle of July what had been a reasonable hope a month before had become a practical certainty. Clearly, little danger from jamming need be feared. Consequently

* It is true that by D-Day at the latest we knew that heavy damage had been done to the German transmitters. But until experience had shown that in consequence the Germans were manifestly unable to jam, General Pile and I would not have been justified in departing from the plan on that account.

there was no need to hide the guns and their radar sets away in folds of the Downs if a better position could be found for them. Was there such a better position, and where was it?

85. These questions were far from simple. The guns could not really be considered in isolation; they were part of a defensive system which also included fighters, searchlights, and balloons. If, nevertheless, the subject was approached from the sole viewpoint of the operational effectiveness of the guns, there was much to be said for moving the gun-belt away from the Downs and putting it on the coast. In this position the gunners would get a better view of their targets; the hampering effect of ground echoes on their radar sets would be reduced to a minimum; and they would be able to use shells fitted with "proximity fuses", which were potentially more effective than normally-fused shells, but could not be used inland because they were dangerous to life and property. Added to this was the important point that if the guns were on the coast the majority of the bombs that they brought down would fall harmlessly into the sea.

86. From a more general aspect there was one weighty argument against moving the guns to the coast. To do so would split the operational area of the fighters into two, and thus, to all appearances, infringe the principle of separate and clear-cut spheres of operation for guns and fighters which I was anxious to establish. Up till then the fighters had been by far the most successful weapon against flying-bombs; out of 1,192 bombs which had been destroyed or brought down up to sunrise on the 13th July, they had accounted for 883. No move which threatened to impair their effectiveness was to be undertaken lightly. Still, to a great extent interception over the sea and interception over the land were already separate problems. Hence in practice the disadvantage of having three spheres of operation for guns and fighters instead of two would not be so great as it looked at first sight.

87. These considerations struck Air Commodore Ambler with great force when he sat down to write the explanation of the new rules for engagement which I had instructed him to prepare. The correctness of the decision to banish fighters from the gun-belt was not in question; nor did he dissent from the proposal to put all the guns in one place. But he felt that to bring this about by moving the guns already on the coast to the North Downs was only going half-way. What was wanted was to put all the guns together in the place where they could function best. In his considered view this meant adopting the opposite course, and sending forward the guns already on the Downs to join those on the coast. The disadvantage of splitting the operational area of the fighters would, he thought, be more than outweighed by the increase in effectiveness of the guns in the latter position.

88. To clarify his mind, Air Commodore Ambler incorporated his arguments in a formal appreciation. Armed with this document, he came to see me on the morning of the 13th July and put his views before me.

89. His arguments convinced me that unless discounted by some faulty technical assumption, the tactical theory behind the case for

moving all the guns to the coast was sound. At the same time I learned that Sir Robert Watson-Watt, the Scientific Adviser on Telecommunications to the Air Ministry, had made an independent study of the problem and reached substantially the same conclusions as Air Commodore Ambler. Sir Robert's opinion, coming from such a distinguished pioneer of radar, carried all the more weight since better conditions for the radar equipment of the guns was one of the main advantages claimed for the proposed change.

90. On the other hand the matter had necessarily to be considered from many aspects besides that to which Air Commodore Ambler, as an Air Staff Officer, had properly confined himself. Even if I accepted the argument that the material and moral effect on pilots of splitting their sphere of operation into two would be no worse than that of excluding them from the existing gun-belt, many practical and administrative factors had still to be taken into account. Hundreds of guns, with all their equipment, were now in position on the Downs. Great reserves of ammunition had been collected there. Thousands of miles of telephone cables had been laid over a period of six months. Accommodation had been found or improvised for the gunners. The best positions available for the guns themselves and their equipment had been selected. In short, a small city was spread out between Redhill and the Thames. The proposal was that we should pick up this city bodily and transport it thirty or forty miles further south. On top of this, for the last two weeks men had been busy building permanent emplacements for the guns among the apple orchards and on the slopes of the chalk hills in Kent and Surrey. The organism was taking root. To transplant it might still be possible, but would not long remain so. Air Commodore Ambler's proposal, with all its consequences, must be endorsed or rejected without delay.

91. I decided to think the matter over during the day and hold a conference late that afternoon, primarily for the purpose of discussing it with General Pile. In the meantime I took steps to acquaint him with the proposal so that he might be in a position to give a considered opinion when the time came. My reflections were punctuated by the intermittent clatter of the bombs, which continually reminded me of the hourly toll of lives and property. The attack that day was the lightest we had had yet; nevertheless sixteen flying bombs crashed into Greater London.

92. General Pile came to the conference with three of his staff. At my request, Sir Robert Watson-Watt also attended, as did the Air Officer Commanding, No. 11 Group, with two of his staff, a representative of the Air Commander-in-Chief, and several of my own staff officers.

93. I opened the conference by outlining the situation. I then asked General Pile whether he supported the proposal to move all the guns to the coast, leaving the balloons where they were, and creating two areas for fighters, one between the balloons and the new gun-belt, and the other in front of the gun-belt, over the sea. He replied that he was in full agreement with it: and in fact, the merits of siting the guns along the coast had been under consideration in A.A. Command for some time.

From the gunners' point of view, such a deployment would present notable advantages. General Pile now proposed that the guns be deployed between St. Margaret's Bay and Beachy Head, and asked that they be given freedom of action inside a strip extending 10,000 yards out to sea and 5,000 yards inland.

94. Air Vice-Marshal Saunders, the Air Officer Commanding, No. 11 Group, might have been expected to demur, since the plan would throw a barrier across the area in which his fighters operated. On the contrary, he welcomed the proposal, which he said was "certainly the most satisfactory plan that had yet been produced". Sir Robert Watson-Watt also spoke in favour of the plan, and undertook to produce improved radar equipment for controlling fighters over the sea.

95. On hearing these opinions, which confirmed the conviction that had been growing in my mind throughout the day, I decided to adopt the plan. This left two courses open to me. On the one hand, since the forces which I intended to re-dispose had already been allotted to me for the defence of London against flying bombs, and no move of guns from one defended area to another was involved, I might regard the change as a tactical one and act at once on my own responsibility. On the other hand, bearing in mind that no move involving so many guns had ever been made on purely tactical grounds before, I might adopt a more proscriptive attitude and refer the matter to higher authority first, as I should have done, for example, if I had proposed to move guns from, say, Manchester to the "Diver" belt, or from Birmingham to Bristol.

96. I decided in favour of the former course. I felt that the situation had reached such a point that no delay could be accepted. If the work on the gun-emplacements on the Downs were allowed to proceed even for another week, the opportunity to shift the guns would be lost. They must be shifted now, or anchored where they were. It seemed to me, rightly or wrongly, that if I were to pause and consult higher authority at this juncture, controversial questions of such magnitude might arise and the further authorities who might claim to be consulted would be so numerous, that I should not reasonably be able to count on a decision before it was too late. Time was running out. It was now or never.

97. I therefore gave instructions before the meeting closed for the new arrangements to be set in train forthwith. General Pile returned to his headquarters, and within a few hours advance parties were on their way to the coast.

98. During the following week vehicles of Anti-Aircraft Command travelled an aggregate distance of two-and-three-quarter million miles in consequence of this decision. Stores and ammunition weighing as much as two battleships, as well as the guns themselves and 23,000 men and women, were moved to the coast, and telephone cables long enough in the aggregate to have stretched from London to New York were laid. By dawn on the 17th July all the heavy guns were in action in their new positions, where they were joined by the light guns two days later.

99. After the conference I acquainted the Air Commander-in-Chief with its outcome. He asked me whether we could not make a trial

deployment on a small stretch of the coast. I replied that half-measures would be worse than useless, and that, taking the view that no more than a tactical re-orientation of resources already at my disposal was involved, I had decided to order the complete move on my own responsibility, and in fact had done so. In accordance with his custom where purely defensive measures were concerned, he did not question my judgment and made no further comment.

100. I was greatly relieved to hear that evening that the move had begun without a hitch, for I was convinced that, whatever the risks involved, we were now on the right track. I had made my decision in full knowledge of the issues at stake and the responsibilities which I was incurring. I was aware that the immediate effect on the performance of the fighters was bound to be adverse, and that if improved results from the guns did not counter-balance this loss within a few weeks, and things went wrong, I alone should be held to blame.

101. In the event, I did not have to wait so long. Within a few days the Air Ministry informed me officially that the Air Staff considered that I ought not to have ordered a major re-deployment of the guns without prior reference to themselves. The move itself was not explicitly disapproved, but I was left in no doubt that thenceforward I should be held personally responsible for the outcome and that any blame or credit that might accrue would be laid upon my head.

102. Despite this intimation the Air Staff continued to give me full support; and I found that at the price of incurring a formal stricture I had purchased an appreciably greater degree of operational freedom than I had hitherto enjoyed. This was to be invaluable in subsequent operations. Happily the performance of the guns in their new positions vindicated the change of plan before many weeks were out, thus proving incontestably the soundness of the deployment which had grown out of Air Commodore Ambler's proposal. The Air Staff were as good as their word in the matter of responsibility for the decision to move the guns; and the effect of the move on the operational results eventually obtained received notice in a letter of approbation sent by the Air Council to my Command at the close of the main attack.

(e) *The Attacks: Second Phase (17th July to 1st September).*

103. Nevertheless the next few weeks were an anxious time. The new system went into effect at dawn on the 17th July. During the following six days 204 bombs reached Greater London out of 473 that came within the compass of the defences. These figures reflected a substantially lower rate of destruction than that achieved during the last week under the old system, although a somewhat better one than we had obtained during the first four weeks of the attacks, before the defences had got into their stride. Analysis of the week's figures showed that—as critics of the new plan had predicted—improved results from the guns and from an expanded and denser balloon barrage had not sufficed to outweigh a sharp decline in the achievement of the fighters.

104. Still, it was encouraging that the performance of the guns had improved at all during a week which had begun with a major upheaval and afforded little time for the gunners to get used to their new positions. As for the decline in the performance of the fighters, this was no more than I had expected. I was not disheartened. Thanks to the energy and skill of the operational and administrative staffs of all Services concerned, the change from the old system to the new had been made without any serious setback. The machine had been brought safely to its new position. It was in running order, as witness, for example, the bringing down of sixty bombs between sunset on the 20th and sunset on the 21st July.* Already the gunners were showing that they knew how to make good use of their opportunities. I felt that one of my main tasks must now be to ensure that the forces directly under my command were made thoroughly familiar with their part in the new plan.

105. I realised that this was a task I must undertake myself. My own staff had their hands full: to devise and apply measures which would ensure that the safety of our own aircraft was not endangered by the "Diver" defences was only one of many duties that called for much careful staff work and painstaking liaison. The Air Officer Commanding, No. 11 Group, and his staff were preoccupied with matters arising out of the operations in Normandy. Realising that this would be so, I had arranged that the Sector Headquarters at Biggin Hill should become a co-ordinating centre for "Diver". I found, however, that the practical, hour-to-hour supervision of operations left the Sector Commander and his staff with little time for other work; and it seemed to me that, in any case, the study and dissemination of tactical doctrine and the promotion of disciplined enthusiasm amongst pilots faced with a novel weapon ought to proceed from a rather higher level than that of a Sector Headquarters.

106. I daresay that, if the circumstances had been slightly different, the best answer to this problem might have been the creation of a Task Force commanded by an officer of air rank answerable to myself for all fighter operations against flying bombs. It would have been necessary to make such an officer responsible for studying tactical methods and the technique of improvised training under operational conditions, as well as for the actual conduct of operations. This would have meant giving him a small staff. I had not the resources to do this, nor the smallest chance of persuading the Air Ministry to provide them. Indeed, in the circumstances this hope would have been quite unreasonable, and I did not entertain it. I felt that this was a case where I must give a direct lead to the Station and Squadron Commanders concerned with flying bombs.

* This figure was made up as follows :

<i>Bombs brought down by</i>			
Guns alone	...	...	23
Fighters alone	...	...	19
Guns and fighters jointly	...	...	1
The balloon barrage	...	...	17
			<hr/>
			60
			<hr/>

107. Here my practice of sharing actively and frequently in the fighter operations stood me in good stead. Trying to shoot down a missile travelling at six miles a minute while flying at the same speed and a height of perhaps a thousand feet across a narrow belt of undulating country bounded by balloons and guns was a business whose subtleties were not readily appreciable from an office chair. I found that a practical acquaintance with this business had its uses. Not only did it help me to acquire a fund of tactical knowledge that I could hardly have gained in any other way; above all it enabled me to talk on a basis of common understanding and endeavour with the pilots whose devotion it was my task to foster.

108. An incidental advantage of the abolition of the inland gun-belt was that it gave the searchlights, which remained when the guns had gone, more scope to assist night fighters. Another unlooked-for benefit of the move was that it brought the headquarters of the A.A. Batteries close to the bases from which our fighters were operating. Immediate and personal contact between Battery Commanders and Station Commanders suddenly became possible and even easy. I found during my first visits to stations after the move that advantage was not always being taken of this proximity. I was shown—as I had been shown for the last five weeks—aircraft whose pilots alleged that the guns had fired at them; I was shown marks of damage said to have been thus inflicted, and fragments of shell-casing which appeared to have entered aircraft or fallen on airfields. In each case I suggested that the Station Commander concerned should pocket the more portable of these exhibits and, armed with this evidence, go and discuss his grievances, real or imaginary, with the local Battery Commander.

109. The hint was taken. The consequences were profound and striking. As a result of these meetings between Station and Battery Commanders, the first requisite of understanding between two parties whose interests must occasionally conflict—the realisation that the other side also has a viewpoint—was attained. The mists of suspicion whose gathering had troubled me so much were dispersed almost overnight. On subsequent visits to the same stations I was again shown aircraft that had suffered minor damage from anti-aircraft fire. But this time, instead of having to listen to grievances against the gunners, I was told of pilots who had flouted discipline and good sense by venturing too near the guns. In short, pilots and gunners were beginning to understand one another's problems and work together. Unity was restored. The process reached its climax towards the close of the main attack. Flying towards the south coast on the 28th August, I could see over Romney Marsh a wall of black smoke marking the position of the "Diver" barrage. From time to time a fresh salvo would be added to repair the slow erosion of the wind. On the far side of the barrage fighters were shooting down flying bombs into the Channel; on the nearer side more fighters waited on its fringe to pounce on the occasional bomb that got so far. The whole was as fine a spectacle of co-operation as any commander could wish to see.

110. That day 97 bombs approached these shores. The defences brought down 90* and only four reached London.

111. Some weeks before this the fact that we were gaining mastery over the flying bomb had become clear to ourselves and also to the Germans. During the second week after the re-deployment of the guns, the defences brought down a higher proportion of the bombs that came within their compass than in any previous week; and only a little more than a quarter of the total got to London.

112. In the following week there was a spell of bad weather, and the fighters did not do so well; but the gunners, whom this factor affected much less, again did better than before. For the first time since the beginning of the attack they maintained a higher rate of destruction than the fighters over a full week. About this time the Meteor, our first jet-propelled fighter, came into service, and I decided to match jet against jet by trying it out against the flying bomb. At first only a few of these aircraft were available, and various problems, including that of limited endurance, had to be overcome before we could get the full benefit out of the Meteor's great speed.

113. As the month went by, all concerned gained further experience and new equipment began to yield results. Soon the overall performance of the defences, and that of the gunners in particular, surpassed all previous achievements. In the middle of August we reached the stage of being sure that, whatever the weather, we could bring down from one-half to three-quarters of all the bombs that approached this island. Indeed, it has been calculated that during the last three weeks of this phase only one out of every seven bombs that the enemy launched actually reached London. Shortly afterwards the enemy High Command permitted the publication in the German press of the significant pronouncement that the Allies had found a counter-measure to the flying bomb. In the last few days of August only an occasional bomb eluded the defences and got through to its target. Thus it is fair to claim that almost complete ascendancy over this novel and ingenious weapon had been gained when, at the beginning of September, the capture of the launching areas by our Armies ended the main attack.

(f) *Attacks with Bombs launched by Aircraft from Holland (9th July to 5th September).*

114. Meanwhile, as early as the 8th July, flying bombs had started to approach London from a new direction, namely from the east. No launching sites were known to exist in Belgium; and after a few weeks it was established that these bombs, which came only at night, were being launched by specially-equipped He. III aircraft operating wholly or mainly from bases in Holland.

* This figure was made up as follows :

Shot down by fighters			
over sea ...	...	13	
over land ...	...	10	
		—	23
Shot down by A.A. guns			
over sea ...	...	46	
over land ...	...	19	
		—	65
Brought down by balloons	...	—	2
			—
			90
			—

115. To meet this new threat I arranged with General Pile that the gun-belt should be supplemented by a gun "box" situated in the quadrilateral Rochester-Whitstable-Clacton-Chelmsford.* By the middle of August 208 heavy, 178 40 mm., and 404 20 mm. guns, besides 108 rocket barrels, were deployed in the "box". I also took steps to extend the balloon barrage to Gravesend,† and fly standing patrols over the mouth of the Thames.

116. During July and August 120 flying bombs were seen or detected approaching this country from the east: the number actually despatched from that direction was doubtless much greater, for launching the bombs from aircraft was a tricky business which must have resulted in many premature descents. There followed a lull that lasted until the early hours of the 5th September—four and a half days after the last bomb had come from northern France—when at least another nine bombs approached London from the east. The "battle of the bomb" was not yet over; but these nine missiles were Parthian shafts, which marked the end of one phase rather than the beginning of another. They were a postscript to the main attack.

(g) *Attacks with Bombs launched by Aircraft from Germany (16th September, 1944, to 14th January, 1945).*

117. The further lull that followed the launching of the last bomb by aircraft operating from Holland lasted the best part of a fortnight; and to many it seemed that "the battle of the bomb" was over. Our Armies were advancing rapidly. Before long they had driven the Germans from every part of the Continent where launching ramps within the existing range of London could be built. The German flying unit responsible for launching the bombs from the air was known to be leaving its bases in Holland and moving north-east. Not only the uninformed, but many in positions of authority concluded with relief that London's long ordeal was ended.

118. This belief was too sanguine. Further attacks with long-range weapons could not be ruled out. Lacking ramps within the existing range of the bomb, and without using their old bases in Holland, the Germans might still send flying-bombs against us. They might increase the range of the bomb and build ramps further back. They might—and certainly could—launch bombs from the air by using airfields in Germany. In the event they were to do both. Moreover, the flying bomb was not their only long-range weapon. They were known to possess a rocket capable of covering more than 200 miles and which was

* An alternative deployment envisaging the mounting of guns on ships moored in the mouth of the Thames, as well as on land, was considered, but rejected because General Pile preferred a deployment that would allow of continuous engagement of bombs by cross fire as they flew up the river, and also because, in any case, not enough ships could have been found to make the plan fully effective. Nevertheless, a few guns mounted on forts and small vessels were eventually included in the eastern "Diver" defences.

† In addition, 1,250 possible balloon-sites north of the Thames were reconnoitred; but I decided not to fly any balloons in that area unless it became essential to do so, since General Pile feared that their cables would hamper the defence of London against orthodox air attack by interfering with the radar sets belonging to the guns.

expected to be ready for use against us during the first fortnight in September. Despite some hopeful statements by men in responsible positions, my staff and I felt that, so long as the Germans continued to hold the western provinces of Holland, we ought to be prepared to meet attacks by the rocket.*

119. That the Germans might still launch flying bombs from aircraft was not disputed by the Air Ministry or the Chiefs of Staff; and I secured authority to keep the existing "Diver" defences in being.

120. By the middle of September the German flying-bomb air-launching unit had completed its move and was installed at bases in western Germany. Towards dawn on the 16th September the attack was resumed. The first bomb fell in Essex at 0549 hours. A few minutes later another came down at Barking. During the next half-hour five more bombs approached this country; one reached Woolwich, one fell at Felsted, and the remaining three were brought down by fighters, one of them into the sea. Two bombs not included in these figures were destroyed at sea by the Royal Navy.

121. After a night of inactivity the attack continued on the evening of the 17th September. Only three bombs came within range and two of them were shot down—one by a fighter and one by gunfire. More bombs followed on the succeeding nights.

122. Countering this phase of the offensive presented special difficulties, because the enemy was no longer tied to fixed ramps. Hitherto he had exploited the mobility of the kind of aerial launching-platform provided by an aircraft only to a limited extent: more than nine-tenths of all the bombs seen or detected up to the beginning of September had come from ramps. Nevertheless the few bombs launched from the air had sufficed to turn the left flank of the defences and compel us to extend it by creating the eastern "box".

123. The advance of the Allied Armies had now forced the enemy back on bases further to the north and east.† Clearly, he intended to make a virtue of necessity by attempting a further turning movement which entailed launching his bombs well out over the North Sea.

124. To meet this move General Pile and I decided to extend the defences northwards by adding to the "Diver Belt" and "Diver Box" a "Diver Strip" extending from the left flank of the "box" at Clacton up to Great Yarmouth. We had already taken some guns from the "belt" to strengthen the "box". We now carried this process a stage further. Between the 16th and 19th September orders were issued to sixteen heavy and nine light anti-aircraft batteries to move from the "belt" to the coast between Clacton and Harwich. As the month went on further moves were

* For an account of the rocket campaign, which was to start on the 8th September, 1944, see Part III.

† There were airfields in northern and central Holland which he might still have used; but tactically they would have been no more convenient than bases in Western Germany, and to supply them with bombs and fuel would have been no easy matter.

ordered; and by the middle of October no less than 498 heavy and 609 light guns were deployed in the "box" and "strip".*

125. The changed direction of attack brought new problems. For various reasons, of which the chief were the intermittent character of the attacks and the geographical position of our own bomber airfields, I could not give the gunners the same freedom of fire as they had enjoyed in the south-east during the summer. Although I was able to establish the principle that flying over the "box" or "strip" below 6,000 feet should be prohibited in normal circumstances during the hours of darkness, I was forced to defer to the needs of Bomber Command to the extent of permitting their aircraft to fly over the "strip" (though not over the "box") at any height they pleased provided they gave prior warning to my headquarters. This concession entailed a corresponding restriction of gunfire; and I also had to reserve the right to restrict gunfire at any other time in order to safeguard friendly aircraft which, for one reason or another, were unable to avoid flying low over the "strip" to reach their bases.

126. Another problem for the guns arose out of the fact that, instead of maintaining a height of 2,000 or 3,000 feet during the greater part of their flight, the bombs launched from aircraft often approached the coast as low as 1,000 feet. A new type of equipment for controlling low-angle fire was coming into service, but only in small quantities; consequently General Pile had to get over the difficulty by siting the rest of his equipment so as to give the best results against low-flying targets. This meant sacrificing some of its capacity to give early warning.

127. Despite these limitations, the performance of the gunners was beyond all praise. Out of 576 bombs which approached the coast between the 16th September, 1944, and the 14th January, 1945, without being shot down into the sea by fighters or the Royal Navy, 321 were brought down by anti-aircraft fire. One hundred and ninety-seven of these fell into the sea and the remaining 124 on land.

128. For the fighters the chief problem arose out of the fact that all activity was now at night. There was a natural tendency to suppose that interception at night would be easier than in daylight simply because the tongue of flame emitted by the bomb was so conspicuous in the dark. Unfortunately, seeing the bomb was not enough: pilots had also to estimate its range, and this proved extremely difficult, as anyone who has tried to judge his distance from a light on a dark night will understand. Sir Thomas Merton, the distinguished spectroscopist, designed a simple range-finder which eventually proved of great value to pilots; but individual skill and experience remained the biggest factor in overcoming this difficulty. Some pilots showed remarkable aptitude for this work, so baffling to many; for example, one Tempest pilot, Squadron Leader J. Berry, shot down more than 60 bombs at night before being himself shot down while on an offensive sortie.

* The permanent defences of towns like Harwich and Lowestoft were incorporated in the "strip" and are included in these figures.

129. During this third phase of the attack we used two types of fighters against flying-bombs at night: Mosquito night fighters in front of the guns, and Tempest day fighters piloted by specially-trained night-fighter pilots between the guns and London. Although the Mosquito was too slow to catch a flying bomb except in a dive, these aircraft brought down a total of 21 bombs during this phase. The Tempests, which had been outstandingly successful during the main attack in the summer, now operated with the aid of a searchlight belt extending from Saffron Walden and Sudbury in the north to Southend and Brightlingsea in the south.* They brought down 50 bombs, most of which fell harmlessly in open country. Thus, throughout the four months of this phase, only 205 bombs eluded the defences out of 608 seen or detected on their way to the capital; and of these only 66 reached Greater London.

130. To supplement these orthodox measures of defence my staff worked out a scheme whereby Mosquito night fighters were sent to the area from which the He. 111 aircraft of the German air-launching unit despatched the bombs, in order to shoot these aircraft down. This was not a simple undertaking. The German aircraft flew low, rising to a height of 2,000 feet or so for only a short time while they released their bombs. Thus the night fighters, too, had to fly only a few hundred feet above the sea. For the fighter as for the bomber this was a hazardous proceeding; and at such low altitudes the radar normally employed by night fighters to make contact with their targets was not at its best. Furthermore, the radar stations on land which were used for controlling the fighters were often unable to detect the bombers except when the latter gained height to launch their bombs.

131. As a step towards overcoming some of these difficulties we modified the equipment of several radar stations and also tried the experiment of controlling the fighters from the naval frigate H.M.S. Caicos and from an aircraft equipped with A.S.V. Mark VI. But these measures bore little fruit until the air-launched attacks were nearly over. All the more credit is due, therefore, to the skill and perseverance of the night-fighter crews, who claimed the destruction of sixteen launching aircraft, the probable destruction of another four, and damage to four more, between the 16th September, 1944, and the 14th January, 1945. There is evidence that these losses, coming on top of the natural hazards incurred by heavily laden aircraft operating almost at sea-level, imposed no little strain on the German unit responsible for air launching.

132. Nevertheless, the Germans seem to have remained unaware how small a proportion of the bombs launched were reaching London, or else to have resigned themselves to receiving a poor return for their efforts so long as some sort of offensive could be continued against this country. For they not only persevered with the operations, but even took steps during the winter to increase their scope. This fact, of which our intelligence service was aware,

* At first these searchlights were deployed at intervals of 3,000 yards. Experience showed that so thick a spacing tended to dazzle pilots and we altered the interval to the normal 6,000 yards.

caused me some anxiety. Although the defences were doing so well, the air-launched flying bomb was still a dangerous weapon because of its mobility. We could not deploy guns everywhere at once; and the bomb might be used against other targets besides London. At that time the country was being bombarded with rockets as well as flying bombs: a simultaneous increase in the scale of attack by both weapons was a contingency against which I felt bound to provide.

133. On the transfer of the Air Commander-in-Chief's main headquarters to the Continent in the autumn of 1944 I had acquired at least a nominal responsibility for directing and co-ordinating offensive as well as defensive counter-measures against flying bombs and long-range rockets. So many authorities whose interests alternately coincided and conflicted were concerned in this matter that my responsibilities were inevitably somewhat indeterminate. Moreover, I was in an even less favourable position than the Air Commander-in-Chief had been to discharge such a responsibility. Like him, I could not help knowing that our striking forces had many tasks to perform besides that of attacking "crossbow" targets. Unlike him, I could not call at my discretion on the tactical, let alone the strategic, air forces for this work. The area from which rockets were being fired against London was within fighter range, and I was able to send fighters and later fighter-bombers to intervene. But the bases of the flying-bomb air-launching unit in north-west Germany were beyond the reach of all my aircraft except those used for long-range "Intruder" work.

134. Thus, so far as offensive counter-measures to the flying bomb were concerned the only thing I could do in practice was to make representations. My staff kept a close watch on the activities of the air-launching unit, and as soon as it was plainly seen to be expanding I urged that its bases be attacked. That the response was not more active was perhaps an inevitable consequence of the multiplicity of calls upon the strategic and tactical air forces, and of the very success which the defences had achieved against the flying bomb up to that time. Even so, a number of attacks on the bases were made by our own Bomber Command and the American Eighth Bomber Command.

135. As a further precaution against a possible extension of the flying bomb campaign General Pile and I took steps to counter any attempt that the Germans might make to turn the northern flank of the defences. A scheme was worked out whereby 59½ batteries of guns could be rapidly deployed between Skegness and Whitby if an attack should develop in that area.

136. This eventuality was realised, without any specific warning on Christmas Eve, 1944. Early on that day about 50 He. 111s—almost the entire operational strength of the air-launching unit—launched bombs in the direction of Manchester from a position off the coast between Skegness and Bridlington. Thirty bombs came within range of the reporting system, and all thirty crossed the coast. Only one of them reached Manchester, but six came down within ten miles of the centre

of the city and eleven within fifteen miles. Thirty-seven people were killed and 67 seriously injured.

137. This was one of the few occasions on which the Germans showed resource in exploiting the capacity of the air-launched flying bomb to outflank the defences. Happily for us they were seldom so enterprising; for however carefully our plans were laid, we could not deploy the defences on every part of the East Coast at once, and if more such attacks from novel directions had been tried, they would inevitably have achieved at least a fleeting success, as on this occasion.

138. Immediately after this attack I ordered that deployment north of the Wash should begin. Shortly afterwards I secured the approval of the Chiefs of Staff to a more comprehensive scheme for the defence of the coast as far north as Flamborough Head. I also arranged that plans should be worked out for the defence of the areas Tees-Tyne and Forth-Clyde. But here again, as in the case of Manchester, I could not afford to order deployment in these areas, at the expense of others, merely on the ground that the enemy might attack them at some future date. Consequently, if he had followed up his attack on Manchester with a series of carefully-spaced attacks at other points north and south of the Wash on succeeding nights, he would undoubtedly have scored some success and set us something of a problem.

139. However, either this did not occur to the Germans, or such an enterprise was beyond the capabilities of an organisation whose spirit was shaken and which was running short of fuel. No more bombs came from north of the Wash; and three weeks later the air-launching unit ceased operations. The last air-launched flying-bomb to reach this country came down at Hornsey at 0213 hours on the 14th January, 1945.

(h) *Attacks from Ramps in Holland (3rd to 29th March, 1945).*

140. This was not the last of the flying bomb. In the meantime the Germans had been working on the problem of increasing the range of the weapon. Fragments of some of the bombs fired from Germany into Belgium in February showed that they were adopting methods of construction which might solve this problem and enable them to attack London from ramps in south-west Holland. Reconnaissance photographs of that area were taken, and showed that two launching sites were being constructed, one at Ypenburg, near the Hague, the other at Vlaardingen, six miles west of Rotterdam. In addition the German built a third site near the Delftsche Canal; but of this we were not aware till later.

141. To meet this new threat General Pile and I decided to reinforce the gun defences between the Isle of Sheppey and Orfordness by transferring 96 heavy guns from the northerly part of the "strip" and adding a number of batteries then under training to the remaining defences in the latter area. Instructions for the move to begin were given on the 27th February and by the 6th March nine batteries out of twelve had taken up their new positions.

In the event, owing to the modest dimensions of the attack, only one further battery was deployed.

142. I also earmarked six Mustang squadrons for operations against the bombs in daylight, and arranged that their engines should be specially boosted. Three of them, together with a squadron of Meteors which I arranged to borrow from the Second Tactical Air Force, were to operate between the guns and London; the other three forward of the guns, over the sea. At night two Mosquito squadrons would patrol over the sea and a squadron of Tempests behind the guns. A direct link with the radar stations of the Second Tactical Air Force in Belgium was set up to assist in giving warning of the approach of flying bombs from the general direction of the Scheldt.

143. The attack began in the early hours of the 3rd March. The first bomb to reach this country got through the defences and fell at Bermondsey at 0301 hours. The next six bombs were all destroyed by anti-aircraft fire: five of them exploded in the air and the sixth fell into the sea. After a lull of nine hours the attack was resumed in the afternoon of the same day and continued intermittently until noon on the 4th, when there was another lull. Ten bombs came over during this second burst of fire: four of them were destroyed by the guns and only two reached London.

144. The second lull came to an end late in the morning of the 5th March. Thereafter, until activity finally ceased on the 29th March, there was spasmodic activity punctuated by intervals of quiet. The performance of the guns during this phase was outstanding.

Indeed, it was so good that, in view of the unexpected lightness of the attack, I was able to dispense with the Meteors and five of the six Mustang squadrons, which returned to their former duties. During the whole of this last phase of the flying bomb campaign 125 bombs approached this country. Eighty-six were shot down by anti-aircraft guns alone, one by the Royal Navy and shore guns jointly, and four by fighters. Only thirteen bombs reached London.

145. Typhoon fighter-bombers of the Second Tactical Air Force attacked the launching-site at Vlaardingen on the 23rd March, Spitfire fighter-bombers of my Command that at Ypenburg on the 20th and again on the 23rd March. At both sites essential components were destroyed. Presumably the missiles launched during the last few days of the attack came from the third site, of whose existence we had not previously been aware.

146. The attacks ended with a bout of intermittent firing between half-past nine on the evening of the 28th March and lunch-time on the 29th. During this period 21 bombs approached this country: 20 were shot down, and the twenty-first came ignominiously to earth at Datchworth, a village of some seven hundred inhabitants twenty-five miles from London Bridge. This was the last bomb of the whole campaign to fall on British soil.

(j) *Summary.*

147. The following table summarises the progress of the campaign and the results achieved by the defences in its various stages:

	Phase 1		Phase 2	Phase 3	Total
	(a) 12/6-	(b) 16/7-	16/9/44-	3/3-	12/6/44-
	15/7/44	5/9/44	14/1/45	29/3/45	29/3/45
(i) No. of bombs reported ...	2,934	3,791	638	125	7,488
(ii) No. of bombs in target area ...	1,270	1,070	67	13	2,420
(iii) Percentage of (ii) to (i) ...	43.3	28.5	10.5	10.4	32.3
(iv) No. of bombs brought down					
(a) by fighters ...	924½*	847	71½	4	1,846½
(b) by guns ...	261½	1,198½	331½	87	1,878½
(c) by balloons ...	55½	176½	—	—	231½
(d) by all arms ...	1,241	2,222	403	91	3,957
(v) Percentage of (iv) (d) to (i) ...	42.3	58.6	63.2	72.8	52.8

* The fractions relate to claims shared between different arms of the defence.

PART III: THE ROCKET CAMPAIGN.

(a) *Intelligence and Countermeasures, 1939 to November, 1943.*

148. The German long-range rocket, known to the enemy as the A-4 and to us as "Big Ben," was a rival to the flying bomb. There is no doubt, however, that if circumstances had permitted, the Germans would have conducted simultaneous campaigns with the two weapons from northern France.

149. The first hint that the enemy intended to use a long-range rocket for military purposes was contained in a report received in this country soon after the outbreak of war. More was heard of the project towards the end of 1942, when agents reported that trial shots with such a missile had been fired shortly beforehand on the Baltic coast. Early in 1943 a connection was established between this activity and the German experimental station at Peenemünde.

150. From that time onwards a stream of intelligence about the rocket reached this country. Not until more than a year later, however, did we receive conclusive evidence about the characteristics and performance of the weapon. During part of the intervening period responsibility for investigating the new threat was taken out of the hands of the intelligence staffs and placed in those of a governmental committee created for the purpose. A number of distinguished scientists and ordnance experts were invited to speculate about the nature of the rocket, and some hypotheses were advanced which ultimately proved wide of the mark. The prevailing impression in responsible quarters during the earlier months of the investigation was that the enemy was forging a titanic weapon which weighed seventy or eighty tons and carried a warhead containing some ten tons of explosive, which would descend upon London with little or no warning. The problem of defending the capital against so obliging a projectile was naturally a source of some anxiety to my predecessor.

151. Towards the end of 1943 a fresh approach to the problem was adopted. In November, responsibility for investigating the nature of the rocket and devising countermeasures was transferred to the Air Ministry. Thereafter, as information from intelligence sources accumulated, a conception of the weapon which was based on reports of what the Germans were doing gradually replaced the earlier conception, which had leaned more towards our own ordnance experts' ideas of a suitable rocket. We shall see that ultimately—although only a week or two before the beginning of the campaign—the intelligence staffs were able to show that the alarms of the previous year had been exaggerated as well as premature, and that the rocket was very much smaller than had been supposed.

152. Meanwhile, by the summer of 1943 the authorities who were then responsible for countermeasures had come to the conclusion that, whatever the dimensions of the missile, radar would probably be able to detect its flight. By the time I took up my appointment in the early winter, five radar stations between Ventnor and Dover had been modified to detect rockets fired from northern France, and operators had been trained to identify the characteristic trace which a rocket was expected to produce. As a further precaution, artillery units in Kent were told to look out for visible signs of ascending rockets and a Survey Regiment of the Royal Artillery was deployed there to take care of audible signs.*

153. These measures had a two-fold object. In the first place, if all went well, the radar, backed up by flash-spotting and sound-ranging troops, would tell us when rockets were fired, and perhaps enable us to give the public a few minutes' warning by firing maroons in London or elsewhere by remote control. Secondly, the information obtained by these means might help us to locate the places from which the rockets were coming, so that we could attack the firing sites and the troops who manned them.

154. To complement these purely defensive countermeasures, an attack, which proved successful, was made by Bomber Command on the experimental station at Peenemünde. Afterwards the Germans transferred part of their activities to Poland. This move somewhat eased the difficult task of our intelligence services in keeping a watch on the rocket trials.

155. During the summer and autumn of 1943 the Germans were observed to be building a number of extraordinary structures in northern France, which we called "large sites".† Agents persistently reported that these sites had something to do with "secret weapons". Their impressive dimensions, taken in conjunction with the exaggerated idea of the rocket which prevailed at the time, led to the notion that the sites were intended for the storage and firing of the missile. Ultimately they proved to have little direct connection with the rocket.

* These activities, which were an extension of those normally conducted in respect of artillery fire, were accordingly known as "flash spotting" and "sound ranging" respectively.

† They were at Watten, Wizernes, Mimoyecques (near Marquise), Siracourt, and Lottinghem in the Pas de Calais, and at Martinvast and Sottevast near Cherbourg. The constructions had few features in common apart from their great size.

156. At this stage Bomber Command and the American Eighth Bomber Command made a number of attacks on one of these "large sites" at Watten. Bomber Command also attacked, as part of their normal programme, several production centres in Germany which were suspected of manufacturing components of the rocket or fuel for it.

(b) *Intelligence and Countermeasures, November, 1943, to August, 1944.*

157. Thus the situation when I assumed control of the air defences in the middle of November, 1943, was that the Germans were known to be experimenting with some kind of long-range rocket.* The intelligence officers on whom the responsibility for establishing the precise nature of this missile would normally have rested had insufficient evidence on which to base any reliable estimate of the date when it might be used against us or the weight of the explosive charge which it would carry. A special investigation had, however, led to much *a priori* speculation about these matters. In consequence the impression had arisen that the Germans were preparing to bombard London with gigantic projectiles each capable of killing hundreds of people and flattening buildings over a wide area. The experimental station at which the weapon was being developed, and where objects some forty feet long which were evidently rockets had been photographed in the summer, had been successfully bombed, as had the first of a series of mysterious constructions in northern France and a number of production centres in Germany. No firm connection between the rocket and the targets in either of these latter classes had, however, been established. Besides taking these offensive countermeasures we had made dispositions which, we hoped, would give us a few minutes' warning of the arrival of individual rockets and also help to tell us where the rockets came from.

158. Soon after I assumed command the discovery of the original flying-bomb launching sites, or "ski sites",† in northern France, taken in conjunction with other evidence, convinced us that the pilotless aircraft or flying bomb was a more imminent threat than the rocket. For the time being, therefore, the latter receded into the background. Early in 1944 I received authority to relax the continuous watch for rockets which had been maintained at certain radar stations since the previous summer. I arranged, however, that the operators who had been trained for this work should remain at the stations and train others, so that the watch could be resumed, if necessary, at short notice. When flying-bomb attacks began next June, I gave orders for the resumption of this watch. Two special radar stations were added to the five whose equipment had been modified.

159. Meanwhile the Allied bomber forces continued to attack the "large sites" as occasion arose and opportunity afforded. At the same time the intelligence staffs at the Air Ministry were gradually piecing together a picture of the enemy's activities at Peenemünde and later also at Blizna, in Poland.

* There were, however, some distinguished disbelievers in the rocket, who continued long after this to argue that the story was a hoax.

† See paragraphs 16-18, above.

Although our ordnance experts continued to believe that anything but an outsize long-range rocket was out of the question, as time went by the evidence began to point more and more clearly to a warhead of relatively modest size.

160. Notwithstanding this evidence, the conception of a huge, earth-shaking projectile persisted. Accordingly much effort was spent on a vain search for the massive launching devices which were believed to be necessary to start so large a missile on its flight.

161. Yet, as the summer of 1944 wore on, the case for the lighter rocket grew stronger. Evidence was obtained that the firing process called for nothing more elaborate than a slab of concrete, on which a portable stand was erected and from which the rocket rose under its own power. By the last week in August all the main characteristics of the A-4 had been established. We knew that it was approximately forty-five feet long and that its all-up weight was less than fourteen tons. We knew that the standard warhead weighed about a ton, but were prepared for the possibility that, by reducing the maximum range from about 200 to 160 miles, the Germans might be able to fit a heavier warhead, weighing up to two tons. We knew that before being fired the rocket was placed upright on the firing platform and there fuelled and serviced—a process which would probably take about two hours. Furthermore, we knew that the Germans had planned at least two methods of storing the missiles, namely in underground pits or tunnels, and in wooden bunkers dispersed in woods. Finally, we had some reason to suspect that active operations would begin during the first half of September.

162. What we did not know was how (if at all) the rocket was externally controlled once it had left the ground. Misleading evidence on this point led to wasted efforts to forestall, detect and hamper non-existent radio transmissions which were expected to be used for this purpose. Not until some time after rocket attacks had begun was the conclusion reached that control of the rocket under operational conditions was entirely internal and automatic, apart from the use of a "beam" to control the line of shoot in certain instances.*

163. The Allied Armies, during their advance through Normandy, discovered a number of sites which the Germans had clearly intended for the firing of rockets. Far from resembling the "large sites", these consisted merely of rough concrete slabs let into the surface of roads. We were bound to assume that similar firing sites existed in areas still in German hands; but their location was unknown to us, and there was not the slightest chance of our detecting them on air reconnaissance photographs.

(c) *The Eve of the Rocket Campaign (30th August to 7th September, 1944).*

164. Such, then, was the state of our knowledge towards the end of August, 1944, when we found ourselves faced with the possibility that rocket attacks might begin at almost any

* In the later stages of the campaign the Germans did, however, use radio for control of range in certain cases. They do not seem to have perfected this technique, which gave less accurate results than their usual methods.

moment. For many months past a system for detecting the firing of rockets had existed, and a programme of bombing attacks on the "large sites" and other objectives suspected of a connection with the rocket had been carried out. In addition the Air Staff at the Air Ministry had devised and kept up to date an elaborate scheme of countermeasures which was to be put into effect as soon as the first rocket was fired.

165. One of the provisions of this scheme was that as soon as attacks were seen to be imminent, fighter aircraft should be held ready to fly armed reconnaissance sorties over the firing areas.* These operations were to be conducted within the "tactical area"† by the Tactical Air Forces, and elsewhere by my Command.

166. Towards the end of the month the stage of imminent attack appeared to have arrived; and the Air Staff decided that we should go a little further than had been contemplated in the paper scheme, by starting to fly the armed reconnaissance sorties without more ado.

167. I had already taken the precaution of authorising my operations and intelligence staffs to issue instructions and memoranda which would enable us to start these operations at short notice; and on the 30th August the sorties began. Since we did not know the location of any firing sites in enemy territory, all we could do was to brief our pilots to recognise anything they might see, and despatch them over the general area from which we expected to be attacked.

168. A few days later, on the 4th September, the rapid advance of the Allied troops into the Pas de Calais and Flanders obliged us to discontinue the sorties. Thereupon I learned that the Chiefs of Staff considered that, since the whole of the Pas de Calais was or shortly would be ours, the threat to London from the rocket could be regarded as over.

169. My intelligence staff felt unable to assent to this opinion without a reservation. They pointed out that the rocket, having a range of 200 miles or more, could still be fired at London from western Holland. Western Holland was still in German hands, and part of it would remain so if the Germans stood on the lower Rhine and the Siegfried Line. True, we had no evidence that the Germans had prepared any firing sites on Dutch soil; but the sites could be so quickly built and were so hard to spot that this proved nothing. While recognising that the Chiefs of Staff were better able than ourselves to foresee the effect of future operations, my intelligence officers felt, therefore, that as things stood at the moment we ought to be ready to meet rocket attacks from western Holland within the next ten days.

170. The logic of this argument was irrefutable; and I was relieved to learn next day that a review of the situation by the Vice-Chiefs of Staff had led to the conclusion that the immediate relaxation of all defensive

* "Armed reconnaissance" is defined as "air reconnaissance carried out by offensively-armed aircraft with the intention of locating and attacking suitable enemy targets".

† This was an area, defined from time to time by the Air Commander-in-Chief, in which the conduct of all air operations devolved upon the Tactical Air Forces.

measures would be precipitate, not because the Vice-Chiefs thought that there was any threat to London, but on the ground that the Germans might still fire rockets at other targets.

171. I mention this divergence of opinion, not to claim superior prescience for myself or my staff, but because the factors involved were so delicately balanced as to give the point some interest. The argument for caution was sound so far as it went, and indeed was shortly to be justified by events; yet there was much that might have been urged on the other side. The disorganisation of the enemy's transport services at this stage must have been so great that he might well have shrunk from the task of diverting the rocket-firing organisation from France to Holland. Again, there was a time during those first few days of September when the possibility that Allied troops might reach Germany in one bound seemed not at all remote; if the Germans had appreciated this, would they have thought an attempt to fire rockets from Holland worth their while? Yet when all this has been said, the fact remains that an area from which rockets could reach London was to remain in German hands for more than seven months to come, and that during this time over a thousand rockets were to fall on British soil.

(d) *The Attacks: First Phase (London, 8th to 18th September, 1944)*

172. In the event, only a few days elapsed before brute fact justified the argument for caution. At approximately twenty minutes to seven on the 8th September Londoners on their way home from work or preparing for their evening meal were startled by a sharp report which sounded almost, but not quite, like a peal of thunder. At 1843 hours a rocket fell at Chiswick, killing three people and seriously injuring another ten. Sixteen seconds later another fell near Epping, demolishing some wooden huts but doing no other damage.

173. During the next ten days rockets continued to arrive intermittently at the rate of rather more than two a day. On the 17th September the Allied airborne operation against the lower Rhine at Arnhem was launched. Thereupon the German High Command ordered the rocket firing troops to move eastwards, and on the following day attacks on London ceased for the time being.

174. Up to that time 26 rockets had fallen in this country or close enough to its shores to be observed. Thirteen of them had landed within the London Civil Defence Region. The higher figure does not represent the total fired during the period, which was certainly not less than 29 and probably well over 30; for we know that a substantial proportion of the rockets despatched habitually miscarried.

175. Early in this opening phase two things about the functioning of the technical devices deployed to detect rockets became apparent. One was that radar stations chosen to detect rockets fired from France were not, on the whole, well placed to detect rockets fired from Holland. Accordingly we arranged to increase the number of stations keeping watch between Dover and Lowestoft from three to six, and to deploy additional radar, sound ranging, and flash spotting equipment on the Continent. No. 105

Mobile Air Reporting Unit was formed within my Command in the middle of September and despatched to Malines, near Brussels, to correlate and transmit the information obtained from technical sources across the Channel. In the meantime the War Cabinet decided that for the moment the public-warning system should not be put into effect. This decision was based on a number of considerations, some of which lay outside my province; but there is no doubt that it was justified on operational grounds alone. If the technical devices had worked perfectly, we could at best have warned the public on any given occasion that the Germans had just launched a rocket which, if it did not miscarry and was not aimed at some other target, would come down somewhere in southern or eastern England in a minute or two. And since at that stage the technical devices were far from working perfectly, our attempts to give even so rudimentary a warning as this would have led, in practice, to many false alarms and the arrival of some rockets unheralded by any warning at all.

176. The other point which emerged during this phase was that, even when the results obtained from the technical devices were good, the calculations based upon them did not, by themselves, enable us to locate the firing points with the accuracy required for the effective briefing of pilots despatched on armed reconnaissance. At best this method told us the position of a site within a mile or two; and until opportunities had arisen of adjusting the assumptions on which the calculations were based by reference to the known location of sites, as established by other means, some of the estimates obtained in this way were manifestly incorrect. Such difficulties were inevitable in the development of a new technique. They did not prevent the radar and sound ranging equipment from giving us useful information from the start. A combination of the data furnished by these two sources confirmed, for example, that the first two rockets to arrive had come from south-west Holland, as our deductions from first principles had led us to suppose they would; and within a few hours "intruder" aircraft of my Command were on their way to that area.

177. After the first day or two, however, we did not depend on technical devices to locate the firing points. One of the first measures taken by the Air Ministry when the attacks began was to brief the Dutch Resistance Movement, through the appropriate channel, to provide intelligence on this subject. A speedy method of getting this information to the Air Ministry was devised. There it was scrutinized by intelligence officers who passed all reports of probable value to my headquarters with the least possible delay. The information contained in these reports was then correlated by a member of my intelligence staff with that based on the data furnished by the technical equipment, as well as that derived from the observations of pilots on armed reconnaissance and of the many flying personnel in the Royal Air Force and the United States Army Air Forces who reported seeing the trails made by ascending rockets. Within a few days the fruits of this process pointed to a number of fairly well-defined areas, all in wooded country in the neighbourhood of the Hague, from which most

of the rockets fired at London seemed to be coming.* By keeping a close watch on the information pointing to these "suspected areas" and ensuring that it was passed to the Fighter Groups concerned by means of frequent and full reports from my intelligence staff, I was able to satisfy myself that our armed reconnaissance effort was employed to the best advantage. During the ten days which this phase lasted, pilots of my Command carried out approximately 1,000 sorties of this kind. They attacked a variety of targets, including road, rail, and water transport vehicles and installations, suspicious constructions, and German troops. On one occasion when Tempests attacked a suspected firing point an explosion occurred so violent as to wreck the leading aircraft. Afterwards a large, shallow crater was seen, such as might have been caused by the detonation of a rocket in the firing position.

178. At this stage I was made responsible for directing and co-ordinating all operations by air forces based in the United Kingdom against the rocket-firing area as well as the bases of the German flying bomb air-launching unit.† This meant that besides using my own aircraft for such tasks as were within their power, I could ask Bomber Command or No. 2 Group, Second Tactical Air Force, to bomb any objectives which seemed to me to call for attack by heavy, medium, or light bombers. But there was nothing mandatory about these requests, and I had no means of ensuring that they were carried out, save that of making representations to higher authority if direct appeals should prove unavailing. My relations with Bomber Command and No. 2 Group left nothing to be desired; but since both had many calls on their resources, mere reiteration on my part and goodwill on theirs were not enough to ensure that my demands should always receive neither more nor less than their due. These difficulties become more intelligible if the requirements for rocket counter measures which preoccupied my attention are fitted into the vast perspective of air operations at that time. In the circumstances it would have been too much to expect a series of firm and favourable decisions on the part of a well-informed and competent higher authority, by means of which alone detailed and adequate response to my special needs could have been ensured. As it was, the Air Commander-in-Chief was busy with the offensive battle, and in any case had no power to direct Bomber Command in matters of this nature; while the Air Staff at the Air Ministry were naturally reluctant to give other than very broad directions to operational commanders.

179. Soon after the rocket attacks had begun, intelligence was received which suggested that the Germans had made preparations to store rockets on three properties situated at Wassenaar, just outside the Hague, and named respectively Terhorst, Eikenhorst, and Raaphorst. At the first two there were comparatively small wooded areas, which for various reasons seemed eminently suitable for the purpose; Raaphorst was a rather extensive property, and we were not sure which part of it was meant. In any case we had no proof that any of the storage shelters which were said

to have been constructed on the three properties were actually in use. Nevertheless, I concluded that the Germans must be storing their equipment somewhere, and presumably also supplies of fuel and rockets, unless they were living entirely from hand to mouth. Accordingly, after weighing the probabilities carefully, I invited Bomber Command to bomb given aiming-points at Terhorst and Eikenhorst. Meanwhile, as early as the 14th September, and before receiving my request, they had sent a small force to attack Raaphorst. An aiming point close to the main road bordering the property was chosen. A few days later fresh intelligence gave us the probable location of three supposed storage areas on the Raaphorst estate, one of them close to this aiming point.

180. The first attack carried out by Bomber Command in response to my request was made on the 17th September, when a small force attacked Eikenhorst, dropping 172 tons of bombs. The bombing was well concentrated and a large explosion was seen to occur in the course of it. No further attacks were made during the first phase of the rocket offensive, which ended on the 18th September.

(e) *The Lull (19th to 25th September, 1944).*

181. During the next week no rockets arrived in this country. Towards the end of that period secret informants reported that the firing troops had received orders on the afternoon of the 17th September to leave the Hague, and been seen departing with their equipment towards Utrecht. We know now that this information was correct; but the arrival of a rocket at Lambeth on the evening of the 18th, coupled with a report that rockets had been fired from Wassenaar on that day and the next, made us a trifle disinclined to give it credence at the time.* I decided that for the present armed reconnaissance sorties over the Hague and its neighbourhood should be continued, and the suspected storage sites at Wassenaar be left on the list of "Crossbow" targets which I wished to see attacked by Bomber Command. If no more rockets should come from the Hague or Wassenaar within the next few days, the sites would lose their value as targets and be taken off the list.

182. Accordingly, aircraft of my Command continued to fly armed reconnaissance and "intruder" sorties over the Hague and its environs during the period from the 19th to the 25th September, so far as the weather and the demands of the Arnhem operation allowed. On the 19th, three whole squadrons from No. 12 Group—to which I had delegated responsibility for supervising the conduct of air operations a few days previously—were sent to attack objectives in an area south-east of the race-course at the Hague, from which we believed the Germans had been firing rockets. Troops, transport vehicles, and buildings there were all attacked. On the previous night (as on two other nights about this time) "intruder" aircraft bombed a railway station at Woerden which an agent had mentioned in connection with the supply of rockets to the Hague.

* During the first phase a few rockets were fired at London from the Island of Walcheren as well.

† See paras. 133-134, above.

* The rocket fired on the 18th must have been a parting shot from a rear detachment of the departing troops. The report that firing occurred on the 19th was doubtless a mistaken one; or perhaps the message was misconstrued.

Neither Bomber Command nor No. 2 Group attacked any rocket targets during the week. Indeed, the latter were not asked to attack any, for up to this time none suitable for the method of precise bombing in which No. 2 Group specialised had been discovered.

183. All this time aircraft of No. 100 Group, Bomber Command, were flying special patrols with a view to intercepting and jamming any radio transmissions which might appear to be used to control the rocket. Aircraft of my Command provided fighter escort for these missions both at this stage and subsequently. In addition, thousands of reconnaissance photographs were being taken and interpreted. This procedure was in accordance with the scheme which the Air Staff had prepared before the attacks began.* One of the provisions of that scheme was that every area indicated by the radar, sound-ranging, and flash-spotting complex as a suspected firing-point should be photographed as soon as possible. My staff pointed out, however, that since many of the estimates based on these data were manifestly incorrect,† and since experience had quickly shown that the firing-points could not be seen on reconnaissance photographs,‡ the procedure served no useful purpose. At our suggestion the Air Ministry agreed to a modification which saved much effort on the part of skilled pilots and interpreters: henceforward only areas in which we expected reconnaissance to reveal something of interest were photographed. We also took advantage of the lull to perfect arrangements for the rapid provision of the "target material" which was used in briefing bomber crews, and to discuss our problems with Bomber Command.

(f) *The Attacks: Second Phase (Norwich, 25th September to 12th October, 1944).*

184. On the evening of the 25th September the lull came to an end. At 1910 hours a rocket fell near Diss, in Suffolk. Neither the flash-spotting nor the sound-ranging troops could give us any useful data about its origin, and at first the radar stations were equally reticent. Even the objective which the Germans had meant to hit remained unknown. Hence the rocket might have come from any area in German hands which was within 230 miles of the point of impact—for this, as we had reason to believe, was the maximum range of the A-4. Thus we were reduced to this hypothesis: that if the rocket had been aimed at London, then it must have come from the Hague or somewhere near it; but if at some other target, then it could have come from another part of Holland, from the Frisians, or even from a part of Germany near Cleves.

185. On the following afternoon another rocket landed in East Anglia—this time about eight miles from Norwich, which subsequently proved to be the target. Once again the technical devices were silent; but five minutes before the rocket fell, chance observers flying over a point about fourteen miles west

of Arnhem saw a trail rise, as they supposed, from a wood some twenty miles away, called the Speulder Bosch and adjoining the village of Garderen. Immediately afterwards the wood appeared to catch fire over an area of perhaps two acres and remain alight for about five minutes. The trail, or one like it, was also seen by chance observers who were flying well north of the Frisians, and thought it came from Ameland or Schiermonnikoog.

186. Now, Garderen lies between Amersfoort and Apeldoorn, in the direction which the firing troops were said to have taken when they left the Hague. Moreover, a secret informant had mentioned Apeldoorn as the apparent destination of a trainload of rockets and fuel which he claimed to have seen a week before. That the rocket which had fallen near Norwich originated from the Speulder Bosch was thus a plausible hypothesis, especially as a trail ascending from that area might well look to observers over the North Sea as if it came from the Frisians.

187. Meanwhile the films which should have recorded any data obtained by the radar stations about the rocket that fell near Diss had been scrutinized without success. They were scrutinized again; and this time faint traces were found on them. These traces showed that the missile had come from a point more remote from the stations than had the rockets observed during the earlier phase of the attacks. Armed with this evidence, the specialist whose task it was to calculate the location of firing points from such data went to work. After some delay he gave an "estimated position" which coincided with the village of Garderen.

188. Superficially the case for Garderen as the new firing area now looked stronger than, perhaps, it really was. The specialist, who was frankly giving an estimate and not the result of a purely objective calculation, may have been influenced by the knowledge that the next rocket was supposed to have come from the Speulder Bosch. If so, the whole case really rested on a single item of positive evidence—the trail seen from a distance of twenty miles. Yet one thing was certain from the impartial testimony of the radar traces: the Suffolk rocket had not come from the Hague or Wassenaar but from some more distant spot. Accordingly I authorised the removal of the suspected storage sites at Terhorst, Eikenhorst, and Raaphorst from the list of "Crossbow" targets which we had furnished to Bomber Command.

189. On the 27th September No. 12 Group sent four Tempest pilots to make an armed reconnaissance of the area between Amersfoort and Apeldoorn. They saw signs of military activity at two points in and adjoining the Speulder Bosch and a third point just south of the neighbouring railway; but there was no proof that this activity had anything to do with rockets. However, on the same day and the two following days six more rockets fell near Norwich and one off the Norfolk coast. In four of these seven cases the information furnished by radar suggested or was consistent with firing from the area between Amersfoort and Apeldoorn. Whether our suspicions of the Speulder Bosch were justified or not evidently

* See paragraph 165, above.

† On several occasions areas under water or otherwise unsuitable for rocket-firing were indicated.

‡ During the previous few weeks nearly 100,000 photographs of western Holland had been examined by interpreters. Not a single firing point had been found.

the rockets were coming from an area so remote that armed reconnaissance of it could not be performed with maximum efficiency by fighters operating from this country. Unfortunately the airfields on the Continent which had fallen into Allied hands were already so congested that facilities for my aircraft to operate from them could not be provided. I could not resist the conclusion that the task must now be done by a force based on the Continent. Accordingly, at the end of September the Second Tactical Air Force assumed responsibility for armed reconnaissance of the firing areas. Air Marshal Coningham's headquarters in Brussels was not well placed, however, for the detailed work of collating intelligence on this subject, which came from a variety of sources; and we arranged that this should continue to be done at my headquarters, where good communications existed. From the 1st October onwards, therefore, my intelligence staff transmitted to Brussels a daily signal—for which we coined the name "Benrep"—containing a brief appreciation of the most recent information and a note of the areas in which armed reconnaissance seemed most likely to be fruitful.

190. Rockets continued to fall near Norwich during the first half of October, but on the 3rd October, as we shall see, London also became a target once again. Thereafter little evidence of firing from Garderen was forthcoming, and most of the rockets apparently aimed at Norwich seemed to come from northern Holland. The evidence of the radar pointed to the shores of the Zuyder Zee and the islands of Vlieland and Terschelling; and secret informants confirmed the presence of firing points in wooded country near Rijs, in the former area.

191. Altogether, from the 25th September onwards, some 36 rockets apparently aimed at Norwich fell on land or close enough to the shore to be reported. Not one fell inside the city, although the enemy's shooting against Norwich was actually somewhat better than that against London, inasmuch as the rounds that reached this country were more closely grouped. The last round of this phase fell on a farm in Norfolk soon after half-past seven on the morning of the 12th October.

192. Meanwhile fighters of the Second Tactical Air Force visited a number of suspected firing areas in the course of the operations of wider scope which they were conducting in support of the campaign on land. Apart from a few trails, however, their pilots saw nothing that threw much light on the activities of the firing troops. But by the end of the attack on Norwich a number of fresh factors had combined to produce a new situation, which ultimately led to a further change in the allocation of responsibility for armed reconnaissance.

(g) *The Attacks: Third Phase (London, 3rd October to 18th November, 1944).*

193. Among the most important of these factors was the resumption of attacks on London. On the 3rd October an agent reported that the firing troops might be in the process of returning to the Hague. Sure enough, late that evening a rocket fell at Leytonstone—the first in Greater London for a fortnight. More followed on the 4th and 7th. By the middle of the month—when attacks on Norwich ceased—the new phase of activity against the capital seemed to be settling down to a rather unsteady

average of two or three rounds a day. The degree of concentration achieved was about the same as in September, but the mean point of impact was further east.

194. So far as we could judge, the Germans were now firing at London from some half-dozen wooded parks and open spaces within the built-up area of the Hague and on its southern outskirts. Possibly a few sites elsewhere were being used as well. The firing troops were said to have taken over a lunatic asylum in the suburb of Bloemendaal and to be storing rockets and equipment in the grounds and neighbouring woods. In addition, informants who had usually proved reliable in the past reported that vehicles and equipment were stored in a wooded park adjoining the Hotel Promenade, in the centre of the town. We were told that supplies were reaching the Hague by way of the goods station at Leiden, and that laden railway trucks were often parked at the main railway station in that town.

195. All this information, and much more besides, we passed to the headquarters of the Second Tactical Air Force by means of the daily "Benreps". Officers from my headquarters visited Brussels to give Air Marshal Coningham's staff the benefit of such experience as we had gained in the first three weeks of the campaign. Both in the "Benreps" and verbally we stressed the desirability of confirming by visual reconnaissance the intelligence obtained from other sources. More than this we could not do. The responsibility for conducting the armed reconnaissance sorties which alone enabled visual observations to be made now rested solely on the Second Tactical Air Force; and according to a recent decision of the Air Commander-in-Chief, this situation was unaffected by the resumption of firing from the Hague.

196. Whatever the merits of this decision, as far as I was concerned the situation to which it led had one grave disadvantage: Air Marshal Coningham, with his many commitments in the battle area, could spare few aircraft for subsidiary tasks. Instead of making sorties over the Hague expressly for the purpose of observing and harassing the firing troops, as my forces had been able to do, the Second Tactical Air Force was obliged to rely on its general programme of armed reconnaissance over the enemy's lines of communication. This method of tackling the problem was probably right in the circumstances; but from my point of view it had several shortcomings. It left us without any means of judging the effect of so indirect a counter-measure; nor did it throw any light on what the enemy was doing at the Hague or meet our demand for visual reconnaissance of suspected areas. Indeed, from the date when the Second Tactical Air Force assumed responsibility for armed reconnaissance up to the 17th October—when this issue came to a head—we were without any report to say that pilots of that Command, while engaged on these duties, had seen or attacked anything on the ground which could be associated with long-range rockets.

197. Another factor which helped to give a new aspect to the problem created by the A-4 was an increasing scale of attack on Continental cities. By the middle of October well over 100 rockets were known to have fallen on the Continent; and with the capture of Antwerp,

whose potential value to the Allies was great, the problem of defending such objectives against both flying bombs and rockets was beginning to exercise the minds of the Supreme Commander and his staff. The likelihood that Antwerp and Brussels would become the main targets for the rocket during the coming winter—possibly to the exclusion of London and Norwich—doubtless contributed to the Air Commander-in-Chief's decision to leave the responsibility for armed reconnaissance with the Second Tactical Air Force even after attacks on London had been resumed.

198. As a result of this quickening of interest in "Crossbow" weapons at Supreme Headquarters, the Supreme Commander directed on the 11th October that the Chief of the Air Defence Division of Supreme Headquarters, who was responsible for co-ordinating terrestrial air defence measures in the north-west European theatre, should also assume responsibility for co-ordinating countermeasures against flying-bombs and rockets in that theatre.

199. The decision to entrust this task to a staff division of Supreme Headquarters itself, and not to the Allied Expeditionary Air Force, foreshadowed the imminent demise of the subsidiary formation. Now that the Allied Armies were firmly established on the Continent, that body, which had been formed primarily to plan and supervise air operations in support of the assault and build-up, was considered to have fulfilled its purpose. On the 15th October, therefore, the Allied Expeditionary Air Force was formally disbanded. Consequently my Command—re-named Fighter Command—and the Second Tactical Air Force became independent formations. Thereupon the constitutional responsibility for the air defence of the United Kingdom which had hitherto rested on Air Chief Marshal Leigh-Mallory devolved upon me, with this difference: I had no control over the Second Tactical Air Force. A situation in which I was responsible for defending the country against long-range rockets while responsibility for conducting the only countermeasure open to a fighter force was exercised by another Command, not under my control, was no longer merely inconvenient; it was clearly untenable.

200. I therefore negotiated with Air Marshal Coningham and with the Deputy Supreme Commander and the Air Ministry a new arrangement, whereby Fighter Command resumed responsibility for the armed reconnaissance of all known or suspected rocket-firing or storage areas in Holland west of a line running north and south through a point approximately 45 miles east of the Hague. At the same time steps were taken to assist the Air Defence Division of Supreme Headquarters in discharging their responsibility in respect of rockets fired against Continental cities. The Supreme Commander had already asked that the 10th Survey Regiment, Royal Artillery, which had been deployed on the Continent in September to undertake sound-ranging and flash-spotting on my behalf, should return to its normal duties in the field. Meanwhile, experience had suggested the possibility of doing without a Survey Regiment in Kent, where the 11th Survey Regiment, Royal Artillery, was deployed. Accordingly arrangements were now made to move the 11th Survey Regiment to

the Continent and place it at the disposal of Supreme Headquarters. No. 105 Mobile Air Reporting Unit, too, was likely to be more useful to Supreme Headquarters than it was to me; and we agreed that this, too, should be handed over. Since the accurate detection and reporting of rockets aimed at Continental targets was of direct as well as indirect benefit to my Command—for without this information we could not be sure of distinguishing the reports that related to rockets aimed at the United Kingdom or assessing their reliability—I readily assented to these changes. I also agreed to lend a number of officers to Supreme Headquarters to assist in setting up the organisation on the Continent.

201. Under the terms of these new arrangements, during the third week in October No. 12 Group once more assumed the responsibility for operations over the Hague with which I had charged them in September. From the 18th October onwards, No. 12 Group, instead of the Second Tactical Air Force, were the primary recipients of the daily "Benrep"; but we continued to keep in close touch with Air Marshal Coningham's headquarters, and reached an understanding whereby the Second Tactical Air Force undertook to do its best to reconnoitre the Hague on my behalf on any day when the weather made flying possible from Continental airfields but impossible from airfields in this country.

202. In the meantime my staff had been making a close study of the intelligence bearing on the disposition of the rocket-firing complex, and had selected five objectives at or near the Hague which seemed worth bombing. Three—the goods station and the railway yard of the main station at Leiden, and the suspected store near the Hotel Promenade at the Hague—were small targets situated close to built-up areas in places whose inhabitants were well-disposed to us and were, indeed, our Allies. On the information I had at the time, these targets seemed eminently suited to the kind of precise attack in which the Mosquito bombers of No. 2 Group specialised. Accordingly we asked that Group to attack them.* The other two—the first consisting of living quarters and storage areas at Bloemendaal, and the second of the storage site at Raaphorst, which was credibly reported to be in use again—were larger and stood in more open situations. We therefore suggested them to Bomber Command as targets for a less precise form of attack. Further enquiry cast some doubt on the validity of our most recent information about Raaphorst, and on the 19th October we withdrew that target from Bomber Command's list, thus leaving them with Bloemendaal as their sole "Big Ben" objective.†

* Air Marshal Coningham, of whose Command No. 2 Group formed part, had agreed to my making such requests direct to the headquarters of the Group in England.

† Strictly speaking, there were two objectives at Bloemendaal, with separate target names and numbers. The storage area round Bloemendaal church was known as "The Hague/Bloemendaal"; the neighbouring lunatic asylum in which firing troops were quartered and whose grounds were said to be used for storing and possibly for firing rockets was known as "The Hague/Ockenburg Klinier". Our suggestion was that the two should be regarded as a single complex, whose internal and external communications could be disrupted at the same time as the living quarters and equipment were destroyed, by bombing two given aiming points.

203. Urgent as these requests were, the entire attention of Bomber Command at the time was being absorbed by tasks to which greater importance was attached. The proposed targets at Bloemendaal were, therefore, not attacked, and after further discussion with No. 2 Group, the goods station and railway yard at Leiden and the storage site near the Hotel Promenade at the Hague were ruled out as not being suitable as precision targets for low level Mosquito attacks. Consequently the Germans were able to develop their offensive, unhampered save by such punishment as fighter-pilots could inflict in the course of armed reconnaissance sorties over an area heavily defended by anti-aircraft weapons.

204. And in fact, as October gave way to November the scale of the German attack rose sharply. During the first three weeks in October an average of two-and-a-half rounds a day reached this country. The average over the next three weeks was four a day; and the week after that it rose to six a day. Six rockets a day was not an intolerable weight of attack, for an individual rocket was not appreciably more destructive than a flying bomb. Yet I became uneasy about the fact that the scale of attack was rising and that comparatively little was being done to check it.

205. On the 17th November I expressed my concern to the Air Ministry in a formal letter. I pointed out that armed reconnaissance was clearly not an adequate method of limiting the German offensive unless supplemented by other measures. Yet no bombing attack on any rocket target at the Hague had been made for two months. Since the Tactical and Strategic Air Forces were not, at the moment, in a position to undertake such tasks, I should have to rely on my own resources. Now, the Spitfire aircraft which I was using for armed reconnaissance had recently begun to carry bombs; but their pilots were precluded from dropping their bombs in circumstances which involved any risk at all to Dutch civilian life or property. I suggested that this injunction should be relaxed to the extent of permitting pilots to bomb such targets as could be accurately located and were situated in areas from which the inhabitants were known to have been removed. In these circumstances the risk to civilian life, at least, would be small; and what we had to do was to balance the off chance of injury to life and property at the Hague against its certainty in London. I asked that this question should be carefully considered, in consultation with the Dutch civil authorities if this were thought fit. Such a concession would also apply, of course, to any attacks that the Mosquito aircraft of No. 2 Group might make.

206. Finally, I asked that consideration should also be given to the desirability of allotting a higher degree of priority to the bombing of rocket targets by Bomber Command. At that time an increase in the scale of attack by air-launched flying bombs was also causing me concern; and I took the opportunity of asking that the bases of the air-launching unit should be attacked as well.*

207. This letter, as I have said, was signed on the 17th November. On that day four rockets fell in London, killing 14 and seriously

injuring 36 people. A gas-holder was set on fire and nine factories were damaged. Only two days earlier ten rockets had landed in this country within 24 hours—six of them in London. Altogether, since the start of the campaign on the 8th September some 200 rockets had arrived in the United Kingdom—an average of three a day.

(h) *The Attacks: Fourth Phase (London, 19th November to 31st December, 1944).*

208. The suggestion made in my letter of the 17th November that the Dutch authorities be consulted was adopted; and on the 21st of the month this point and others raised in my letter were discussed at one of the Deputy Supreme Commander's conferences at Supreme Headquarters. Thereupon, with the concurrence of the Air Staff, I was authorised to undertake fighter-bomber operations on the lines I had laid down. On the other hand, I was given clearly to understand that for some time to come any assistance I could expect to receive from the Second Tactical Air Force would be virtually limited to that provided by their current rail interdiction programme.* I was also informed that, unless the enemy increased his scale of attack considerably, the Combined Chiefs of Staff would not be likely to countenance the diversion of any part of the strategic bomber effort from the attack of the German petroleum industry and communications to that of rocket targets. The Air Staff assured me, however, that if the scale of attack by "Crossbow" weapons did increase, the matter would be reconsidered.

209. No time was lost in taking advantage of the concession regarding fighter-bomber operations. My staff drew up a list of storage sites and similar objectives all situated at least 250 yards from the nearest built up area; and from the 21st November onwards the four squadrons in No. 12 Group which were assigned to this duty† took every opportunity of attacking them with bombs and machine-gun and cannon fire. The general prevalence of bad weather made these opportunities few, especially in November and the latter half of December. As a result, these squadrons had plenty of time for intensive training in pin point dive-bombing, of which they took full advantage, and during the first half of December, when the weather temporarily improved, more frequent attacks were made. Altogether, between the 21st November and the end of the year No. 12 Group made 470 fighter-bomber sorties against rocket targets

* This programme included attacks on railway bridges at Deventer, Zwolle, and Zutphen, which some competent judges considered the most promising form of countermeasure to the rocket offensive from western Holland.

† The squadrons were:

No. 453 Squadron	Spitfire XVI
No. 229 Squadron	Spitfire XVI
No. 602 Squadron	Spitfire XVI
No. 303 Squadron	Spitfire IX

The Spitfires XVI were each capable of carrying two 250 lb. bombs and an overload tank which enabled them to fly to and from their bases in England without refuelling on the Continent. By refuelling in Belgium—which became possible on a strictly limited scale at the end of November—they could dispense with the tank and carry twice the load of bombs. The Spitfire IX could carry at most one 500 lb. bomb and that only by refuelling in Belgium. At this stage, therefore, we did not normally use No. 303 Squadron to carry bombs.

* See paragraph 134, above.

and dropped 54 tons of bombs in the course of them. In these operations no effort was spared to ensure that the bombs were dropped with a skill and precision rivalling that displayed by the picked crews of No. 2 Group in some of their spectacular attacks on buildings used as headquarters by the Germans. A characteristic attack delivered during this phase was one made by Nos. 453, 229 and 602 Squadrons, on Christmas Eve, on a block of flats near the centre of the Hague, which the Germans were using to house the firing troops in that district. The building was so badly damaged that the Germans had to leave it.

210. To all appearances the influence of these operations on the rate and quality of the enemy's fire was considerable. The scale of attack declined from an average of nearly seven rockets a day at the end of November to four a day in the middle of December and three-and-a-half at the end of the month. Moreover, the enemy took to doing most of his firing at night, and the apparent accuracy of the shooting decreased. A statistical analysis of the rocket effort and our counter-measures led to the belief that sustained attacks on the firing areas by day and night would exercise a cumulative effect on the enemy and hence on the number of rockets that reached London.

211. At the time I was not altogether prepared to accept this conclusion. In the light of subsequent experience I feel quite sure that to do so would have been to claim too much for our efforts. The chief factor in limiting the scale of attack was almost certainly the rate at which supplies could be brought to the firing areas; and this in turn must have been mainly determined by the frequency and success of the armed reconnaissance and rail interdiction sorties flown by the Second Tactical Air Force over the enemy's lines of communication. Preparations for the German offensive in the Ardennes—which was accompanied by an increased scale of rocket attack on Antwerp—may also have helped to diminish the attack on London towards the end of 1944. The simultaneous decline in accuracy is not so easily accounted for; and its significance in view of the comparative smallness of the figures analysed is open to question.

212. On the other hand the enemy's new tendency to fire most of his shots at night was definite and unmistakable. For this change of habit by the Germans our fighter-bombers may perhaps claim the credit, since it cannot readily be explained on any other grounds than a desire to evade their attention. Admittedly the gain was an indirect one, seeing that fire at night was no more inaccurate than by day; in fact, as a general rule a higher proportion of the rounds fired in darkness hit the target than of those fired by day; but casualties were generally lower after dark, when most people were at home, than in the daytime, when they were massed together in factories and offices and in the streets. Thus, from our point of view the preponderance of night firing was definitely favourable.

(i) *The Attacks: Fifth Phase (London, 1st January to 27th March, 1945).*

213. However, the respite was short-lived. In the New Year the scale of attack went up again. During the first half of January an

average of more than eight rockets a day reached this country. Thereafter the rate of fire declined a little, only to rise again early in February, until an average of ten rockets a day was attained in the middle of the month. Moreover, the Germans again took to doing more than half their firing in daylight, and their accuracy improved. In an average week in January and the first half of February, twice as many people were killed or seriously injured by rockets as in a corresponding period in December.

214. Clearly, our fighter-bomber programme was not such an effective deterrent as we had hoped. This was not to say that our methods were wrong; without the fighter-bomber attacks, the rate of fire might have risen still more sharply. But evidently something more was needed if the German offensive was to be kept down.

215. What form that something more should take was not so obvious. In December the Air Ministry had asked the Foreign Office and the Ministry of Economic Warfare to investigate the possibility of curtailing supplies of fuel for the A-4 by attacking factories where liquid oxygen was made. The experts reported that there was no means of knowing which of the many factories in German hands or under German control were supplying liquid oxygen for that particular purpose. There were, however, eight factories in Holland, five in western Germany, and five elsewhere in Germany which might fill the bill. As a sequel to this investigation, the Air Ministry invited me to consider attacking three factories in Holland. One of them, at Alblisserdam, near Dordrecht, was successfully attacked by the Second Tactical Air Force on the 22nd January. Another, at Ijmuiden, consisted of two buildings so closely surrounded by other factories that the prospect of a successful attack with the means at my disposal was remote. The third, at Loosduinen, on the outskirts of the Hague, was adjoined on three sides by Dutch civilian property. Hence I was reluctant to attack it, especially as there was no certainty that its destruction would cause the Germans to fire even one less rocket at this country. However, in view of the Air Ministry's request and my desire to leave nothing undone which offered a chance of hampering the enemy, I agreed to do so. In order to reduce the risk to civilian property to a minimum, the pilots chosen for the job were instructed to use methods which can best be described as "trickling their bombs towards the target". This technique necessitated five separate attacks of which all but one were made from the direction in which there were no houses adjoining the factory. Two attacks were made on the 3rd February, two on the 9th February, and one on the 8th. After the last attack on the 9th we judged that the target had suffered enough damage to be left alone in future.

216. In January bad weather limited the number of fighter-bomber sorties that we could make to a little more than half the number made in December. In February the weather was better and during the first half of the month we made more fighter-bomber sorties than in the whole of January. Besides delivering the five attacks on the oxygen factory at Loosduinen to which I have alluded, we made six attacks on the Haagsche Bosch, a

wooded area in which rockets had been seen on reconnaissance photographs taken in December. The Hotel Promenade was attacked on three occasions, and attacks were also made on other suspected storage areas at the Hague, Wassenaar, and the Hook of Holland, as well as on railway targets. The Second Tactical Air Force continued to attack communications, as hitherto, in the course of their armed reconnaissance and rail interdiction programmes.

217. Meanwhile, in consequence of the rise in the scale of rocket attack, towards the end of January the Air Ministry had begun to press me to intensify my efforts against the firing and storage areas. Nevertheless they were still unwilling to see any part of Bomber Command's effort diverted to the attack of such targets. On the 26th of the month, however, the Defence Committee agreed to invite the Air Ministry to ask Supreme Headquarters to sanction the precise attacks on selected targets by the light bombers of No. 2 Group, which I had been urging since the previous autumn. Shortly before this I had arranged to raise the strength of the force earmarked for exclusive use against rocket targets from four squadrons to six, and to equip and use all six squadrons regularly as fighter-bomber squadrons.* I now negotiated a new agreement with the Second Tactical Air Force whereby my area of responsibility was extended as far east as Amersfoort. On days when the weather was unsuitable for precise attack on objectives at the Hague, our fighter-bombers were now attacking rail targets; and the inclusion of Amersfoort in our area would enable us to bomb the railway junction there—a bottleneck through which all traffic from Germany to the firing areas in western Holland passed. Under the terms of the new agreement the Second Tactical Air Force would use any light or medium bombers that they could spare from the battle on land to attack rocket targets chosen from lists provided by my staff.

218. The full effect of the expansion of the "Big Ben" fighter-bomber force was seen in the second half of February, when Fighter Command made 548 sorties and dropped 108 tons of bombs—precisely the same weight in two weeks as in the previous six. At the suggestion of my Chief Intelligence Officer, who recommended that we should try the effect of concentrating our efforts on a single target for at least a week, nearly three-quarters of this bomb tonnage was aimed at the Haagsche Bosch, where severe damage was done, particularly on the 22nd February, when a film studio which the Germans used for storage was gutted. An almost complete cessation of rocket fire over a period of more than sixty hours followed this attack; and on the 24th February photographic reconnaissance failed to reveal a single rocket anywhere in the square mile or so of wooded parkland that the Haagsche Bosch comprised. Other evidence strengthened the inference that the Germans had been driven from the Haagsche Bosch, at least for the time being, and suggested that they had been forced to improvise facilities in the racecourse area at Duindigt, further to the north.

219. So far as they went, these results of our new policy of concentrating on one area were encouraging; but events soon showed that no lasting effect on the Germans had been achieved. When firing was resumed (apparently from Duindigt) on the 26th, no appreciable decline in its quality or quantity was apparent. Nor did the first of No. 2 Group's long-awaited bombing attacks, which was delivered on the 3rd March, have any better effect. The attack was delivered by 56 Mitchells, and the target chosen—not without some misgivings since the continued presence of the Germans and their gear was doubtful—was the Haagsche Bosch. Unfortunately the bombing was not sufficiently accurate, in consequence of which casualties occurred among Dutch civilians and their property was damaged. After this unhappy experience, Air Marshal Coningham decided to make no more attacks on targets at the Hague.

220. Another counter-measure considered at this stage was the use of anti-aircraft artillery to fire at approaching rockets and explode them in the air. If only because the rockets travelled many times faster than the fastest bomber and completed their parabolic flight from Holland in less than five minutes, the problems involved seemed formidable. Indeed, proposals in this sense had been carefully considered before the attacks began and found impracticable. General Pile raised the subject again in December, 1944, when he asked permission to make an operational trial of a scheme designed to ensure that the rockets would pass through a curtain of shell-fragments as they approached the earth. An essential requirement of the plan was accurate and timely warning that a rocket was on its way. Although there were still difficulties in the way of disseminating such warnings to the public, for operational purposes reliable information of this kind was now available. There were some obvious drawbacks to the scheme: for example, the expenditure of rounds required to explode even one rocket was likely to be extravagant and possibly alarming to the public. Nevertheless, I was satisfied that it contained the germ of a successful countermeasure, which might become important in the future, and that on purely operational grounds a practical trial was desirable. I made recommendations to this effect when submitting General Pile's proposal to higher authority. The committee before whom the scheme was laid, after taking the opinion of eminent men of science, one of whom put the chances of a successful engagement at one in a hundred and another at one in a thousand, decided that an operational trial would be premature. They invited those concerned to seek ways of improving the scheme, and promised to consider it again in March.

221. Accordingly General Pile repeated his request for an operational trial towards the end of that month. He pointed out that time was clearly running out: the opportunity of testing the scheme in practice would soon have passed. In response, on the 26th March a panel of scientists were asked to prepare a theoretical estimate of success. They reported on the same day that if 400 rounds were fired against any one rocket the chance of scoring a hit would, at best, be one in thirty. After a further statement by General Pile, who said

* The additional squadrons selected were Nos. 451 (Spitfire XVI) and 124 (Spitfire IX, modified for bombing).

that he would endeavour to increase the chance of success by trebling the rate of fire, the proposal went before the Chiefs of Staff, who decided on the 30th March that the likelihood of success was too small to outweigh the objections to the scheme. But in any case, by that time the campaign was over.

222. Meanwhile we had been continuing our fighter-bomber offensive against the rocket-firing organisation and its communications. After the 3rd March we made no further attacks on the Haagsche Bosch, but turned our attention to the adjoining racecourse area at Duindigt, along with other storage and firing areas and a group of buildings belonging to the Bataafsche Petroleum Company, which apparently the Germans were using as billets and offices. As before, we selected railway targets for attack when conditions were unsuitable for attacking our primary objectives. During the second week of March alone we dropped some 70 tons of bombs at Duindigt. By the middle of the month we had evidence that the Germans had abandoned the area, which was by that time so pitted with craters that, in the words of a contemporary report, "it looked as if Bomber Command, not Fighter Command, had been attacking it". This success was accompanied by another temporary decrease in the scale of rocket attack on London; and what was, perhaps, more significant was that about this time the Germans took to doing more and more of their firing in the early hours before dawn. We concluded that our efforts had spoilt their arrangements for storing rockets in the forward area and that they were being forced to bring the missiles up at night and fire them off as soon as possible. Accordingly, during the second half of March we paid little attention to storage areas and devoted most of our fighter-bomber effort to communications. Altogether we made more fighter-bomber sorties in March than in the previous four months put together, and dropped more than three times the weight of bombs dropped in February.

223. The German offensive came to an end at 1645 hours on the 27th March, when the one thousand, one hundred and fifteenth rocket to fall in this country or within sight of shore fell to earth at Orpington, in Kent. The campaign had lasted seven months. During that time the Germans had fired at least 1,300 rockets at London and some 40 or more at Norwich. Of these 518 had fallen within the London Civil Defence Region and none at all within the boundaries of the latter city. Altogether, 2,511 people had been killed and 5,869 seriously injured in London, and 213 killed and 598 seriously injured elsewhere. These figures would have been substantially smaller but for a number of unlucky incidents, in which rockets chanced to hit crowded buildings. Among the worst of these incidents were three which occurred at New Cross Road, Deptford, on the 25th November, 1944, and at Smithfield Market and Hughes Mansions, Stepney, on the 8th and 27th March respectively. Deplorable as these occurrences were, their rarity is a measure of the random quality of the long-range rocket in the stage to which the Germans had developed it.

224. Yet the A-4 rocket cannot be dismissed as a mere freak. Practically, it was a new weapon, which brought new hazards to the

lives of millions, and set new problems of defence. Its significance, and that of the flying-bomb, when posed against the wider background of the war as a whole, remain to be considered.

PART IV: A SUMMING UP.

225. In describing our countermeasures to the flying bomb and A-4 rocket, I have been at pains to point out that these measures were only a part of operations of much wider scope, ultimately extending over the greater part of Europe. Perhaps a balanced view is best preserved by remembering that although defence against these two weapons formed the main task of the air defences during a period of nearly ten months, operations directly concerned with the bomb and rocket absorbed only a fraction of the total Allied air effort, offensive and defensive. From the time when attacks on "Crossbow" targets began, in August, 1943, until the end of the war with Germany, these operations accounted for about eight per cent. of the total weight of bombs dropped by the tactical and strategic air forces in the western theatre. On the other hand, the number of guns and balloons concentrated in south-east England that summer as part of our defences against the flying bomb was certainly the greatest ever assembled in a comparable area for the purpose of air defence. The fighter squadrons deployed in this role were limited in number by geographical conditions; but they included some of our fastest aircraft, which had to be withheld from operations in the tactical area.

226. This leads naturally to the question: to what extent did this expenditure of effort prevent the Germans from doing what they set out to do? An answer calls for a few comments on what the German intentions seem to have been. When accelerated development of the A-4 rocket began in 1942, the Germans cannot have known very clearly what they meant to do with it. Not only had the capabilities of the weapon yet to be established, but in any case the formulation of precise strategic aims does not seem to have been the enemy's strong suit. In the OKW* the Germans possessed what the Allies sometimes accused themselves of lacking—namely, a permanent and fully equipped organ for the supreme direction of the war. In practice, however, it failed to come up to expectations. For this there seem to have been two reasons. For one thing, Keitel, the head of the OKW, lacked a forceful personality. For another, the selection of his staff was entrusted to the General Staff of the Army, who were not so innocent as to put a rod for their own backs into the hands of men remarkable for their vigour. Hence the OKW worked less as an authoritative body than as a kind of secretariat to the Fuehrer. Hitler was thus the only man in Germany really in a position to settle problems of overall strategy.

227. Hitler, we are told, had little taste or aptitude for long-term planning, though his intuitive judgment of immediate issues was phenomenal. Such qualities as this were not enough to ensure a consistent aim or policy. When firm direction from above was lacking, the three fighting services pursued separate and

* *Oberkommando der Wehrmacht*, or Supreme Command of the Armed Forces.

sometimes divergent courses. "Because of the impotence of the OKW," says Albert Speer, the former Reichsminister of Armaments and War Production, "I had to negotiate and make decisions separately with the three Services."

228. According to the same authority, the development of the flying bomb was begun towards the end of 1942 because the German Air Staff grew jealous of the success achieved by the Army in developing their own long-range missile, the A-4 rocket. Thus, from the outset the two weapons seem to have been competitors. An attempt to co-ordinate their use at the operational level was, however, made in December, 1943, when a military formation called LXV Army Korps was given overriding control over both weapons. The efficacy of this measure is doubtful, since the staff of LXV Army Korps seem to have had an imperfect understanding of the flying bomb, and were sometimes at loggerheads with Flakregiment 155 (W), the Luftwaffe formation immediately responsible for its operation. I daresay there was something to be said on both sides.

229. Despite these disagreements and uncertainties, by the spring of 1944 the notion of using the two long-range weapons to remedy the shortcomings of the bomber force seems to have been generally accepted. Outwardly the odds against a German victory had become so great that those in the know could hardly have found the will to go on fighting if they had not been sustained by the mysterious promise of new scientific marvels, reinforced by the hope of driving a wedge between the Allies. Koller, the last Chief of the German Air Staff, has said that "the final role of the flying bomb and the A-4 rocket was to replace the bomber arm of the Luftwaffe entirely." Hitler expressed a similar intention when addressing representatives of Flakregiment 155 (W) at Berchtesgaden soon after the flying bomb campaign had begun. Yet even at that stage inconsistencies of aim and viewpoint were evident. Only a few months earlier the aircraft industry had been directed to continue the production of bomber types; while LXV Army Korps, true to its tradition of conflict with Flakregiment 155 (W), envisaged the simultaneous use of flying bombs and bombers. Finally, Goering, who as head of the Air Ministry and Commander-in-Chief of the Luftwaffe was ultimately responsible for the decision to adopt the flying bomb, is said to have had little faith in the weapon; while Speer, who was ultimately responsible for its production, was certainly not unaware of its defects.

230. On one further point, at least, the Germans were agreed: the time to use the long-range weapons was *before* the Allies could set foot in north-west Europe, in order to postpone the day and gain time for dissension to spring up between the United Kingdom, America and Russia. The A-4 rocket was an ill-favoured monster, slow to reach maturity; but tests of the flying bomb in the summer of 1943 were so promising that the commencement of active operations before the end of the year was ordered. Whether attacking London with flying bombs was a good way of upsetting Allied plans for the assault is arguable; but very likely the Germans clung to the hope that opposing views about the diversion of our

resources to the defence of the capital would split the western Allies, and the consequent delay in opening the new front detach us both from Russia.

231. The bombing of the "ski sites" and other factors led to a postponement of this programme. The landings in Normandy on the 6th June, 1944, took the Germans tactically by surprise and found them still not ready to use the flying bomb. Thereupon LXV Army Korps, apparently on Hitler's instructions, peremptorily ordered Flakregiment 155 (W) to begin operations on the 12th June. The precise grounds of this decision are never likely to be known. The opportunity to use the long-range weapons to delay the Allied assault had gone, if indeed it had ever existed. But the Germans may still have hoped to gain time by exploiting the harassing effect of the bomb and hampering the flow of reinforcements and supplies. Moreover, it is improbable that we need look very far for the motive that prompted such a natural reaction to events. At moments of crisis the impulse to retaliate against an England which had upset all Hitler's plans by perversely refusing its allotted role was never far below the surface. The Germans quickly publicised the flying bomb as "revenge weapon No. 1": and their propaganda may well have contained a hint of their real purpose. With the "west wall" in jeopardy and defeat on the horizon, Hitler may have seen no more than the need to strike back and hope for a miracle.

232. In any case such hopes as the Germans may have entertained were bound to be disappointed. During the next ten months they were to launch well over 10,000 flying bombs at London, thereby squandering about a million and a half gallons of sorely-needed petrol and a productive effort which, according to Speer, would have been better employed in turning out 3,000 fighters. Whether Germany would have gained anything decisive if every one of those peevish darts had found its mark is open to question. But for us the effects would certainly have been embarrassing. As it was, our casualties in the two V-weapon campaigns included 8,938 persons killed and 24,504 seriously injured, while over 200,000 houses were destroyed or severely damaged and over a million more suffered less important damage. We may therefore be thankful that the number of bombs which reached the London Civil Defence Region was not 10,000 but 2,419.

233. I fancy that Londoners in particular will readily acknowledge their debt to the gunners, fighter crews, balloon crews, and a host of others whose skill, devotion, and unflinching toil brought about the premature descent of far more bombs than reached the target. Nor will they forget the involuntary but cheerful contribution of their neighbours in Kent, Sussex, Surrey, and other counties surrounding London, whose fields and gardens were graveyards for buzz-bombs stricken by the way. Despite the care that we took to bring the bombs down away from houses whenever we could, the path of damaged or defective bombs was sometimes unpredictable. Like their neighbours in London, some of the dwellers in "bomb alley" met their deaths in the front line. It is right that I should record, however, that our efforts were so far successful that the casualties caused by the bombs which failed to reach the target were only a fraction of the total.

234. In this battle the part played by gunners and fighters was so conspicuous and important that it tends to monopolize attention, perhaps unduly. I am conscious that in writing the foregoing account of the flying bomb campaign I have not resisted the natural tendency to bring out those features which make for easy narrative and positive statement. I wish, therefore, in this summing up, to emphasize that victory over the flying bomb was gained by the joint efforts of thousands of men and women of the different Services, working in every variety of unit and at all levels of responsibility. As an example of this co-operation I may cite the mutual trust and unity of purpose that always existed between General Pile's staff and mine. So far as the work of the gunners and fighter crews is concerned, the bare chronicle of their achievements requires no embellishment. Nothing need be added, therefore, except perhaps a word of tribute to those whose work was done outside the limelight. The contribution of Balloon Command, too, speaks for itself, although perhaps in too modest a tone for its true value to be apparent. Every one of the 232 bombs brought down by the balloons was one which had eluded the other defences and would almost inevitably have hit the target if it had been allowed to continue on its way. To the administrative skill and practical efficiency which enabled the deployment of the initial barrage to be completed in less than a third of the time originally forecast, I can give no higher praise than by comparing this feat with those performed by Anti-Aircraft Command at the same time and in July. The part played by the Royal Observer Corps—the Silent Service of the air defences—was an epic in itself. Together Anti-Aircraft Command, Fighter Command, Balloon Command and the Royal Observer Corps made up a team in whose play I am proud to have had a share.

235. Of the helping hand extended by many who were not members of the team, limitations of space forbid that I should say much. A hint has already been given of the technical advice and assistance rendered by distinguished men of science. Acknowledgement must also be made of the important part played by the Royal Navy and the Admiralty, especially in connection with the problems of obtaining and utilising early warning of the approach of flying bombs over the sea, and also that of helping pilots to "pinpoint" their position off the coast. In particular, the heroism of those who sailed in the small craft which operated off the French coast, under the noses of the Germans and exposed to attack by land, sea, and air, deserves to be remembered.

236. Teamwork, aided by such help as this, won the "battle of the bomb". Indeed, it is not too much to claim that the flying bomb was prevented from achieving even a secondary purpose; for although we suffered casualties and damage, the flow of supplies to the Allied Armies across the Channel went on unimpeded by the worst the flying bomb could do.

237. Such, then is the answer to our question, so far as it concerns the flying bomb.

238. I turn now to the A-4 rocket. This was in some ways a more disturbing menace than the flying bomb. Not that it was more destructive; but it was difficult to counter, and

fore-shadowed further developments which still loom ahead of us. Albert Speer, one of the ablest and most far-seeing of our enemies, remarked soon after the German surrender that, whereas the flying bomb had had its day, the rocket must be considered the long-range weapon of the future. On the other side of the scale must be set the complication and high cost of such missiles. Delivering approximately the same explosive charge as a flying bomb, the A-4 rocket required twenty times the productive effort, or as much as six or seven fighters.

239. That the German rocket attacks of 1944 and 1945 were conceived with a well-defined military object in view is open to doubt. I fancy that if the situation had been less desperate the Germans might have postponed active operations until further trials enabled them to attain a higher standard of accuracy. Their plight was such, however, that in September, 1944, they found themselves constrained to improvise a rocket offensive from Holland in order to cushion the shock resulting from the obvious failure of the flying bomb. This does not mean that if northern France had remained in their hands, and our countermeasures to the flying bomb been less successful, they would not have used both weapons together; but that in such circumstances the use of the rocket would have been equally premature. The standard of accuracy attained, the many misfires, and the inconsistency of method adopted by different firing units, all point in the same direction.

240. To an even greater extent than the flying bomb campaign, then, the rocket offensive must be regarded merely as a harassing attack. In the outcome it was not particularly successful in that capacity. Why was this? The contribution of the defences, as I have related, was practically limited to tracking the missiles, trying to locate the firing points, and attacking these and other targets more or less frequently and more or less effectively with fighters and fighter-bombers. As I urged at the time, these measures were not, by themselves, enough to interfere seriously with the rate or quality of the enemy's fire. The ineffectiveness of the A-4 rocket was due rather to the inaccuracy of the weapon and to the restricted scale of attack, reduced as it was by the enemy's insistence on dividing his efforts between Antwerp and London, probably from propagandist motives. But to say this does not imply that no effective countermeasure to the rocket would have been possible in any circumstances. In one sense its very lack of weight was what made the attack so hard to counter. For if the enemy had begun to fire at a much greater rate, he could no longer have lived from hand to mouth. He would have been obliged to store rockets and fuel in bulk near the firing area. Valuable bombing targets would then have been offered to us; and in such a case the Chiefs of Staff would doubtless have considered lifting their virtual ban on the use of the strategic bomber forces against rocket targets. I have little doubt that if this had been done and the diversion of part of our bomber effort been accepted, we should soon have been able to restore the scale of rocket attack to its original proportions.

241. Accordingly, so far as the rocket was concerned the answer to our question is that, although in the circumstances the effect of the

defences was small, potentially we had the means of keeping the situation in hand if the scale of attack had risen.

242. On the broader issue of the extent to which the Germans were right, in the military sense, to develop their two long-range weapons and put them into operation, a number of questions naturally arise. Would several thousand fighters have been worth more to the enemy than the 20,000 flying bombs and 3,000 rockets, or thereabouts, which he aimed at England and Continental cities? Put thus, the issue is misleadingly simple; the fighters would have been no use without pilots, ground crews, bases, and supplies of aviation spirit greater than the Germans could command. If this effort had been put into the production of bombers instead, the Germans would still have been no better off: the crews and the aviation spirit would not have been forthcoming. And indeed, since by the time the most important decisions were taken the Luftwaffe had lost much of its striking power, the devotion of so much skill and manpower to the flying bomb and the A-4 is at least understandable. The former was an ingenious weapon, which we might not have overcome if we had been less well prepared; the latter a notable advance on anything that had gone before, and a source of problems with which the nations are still grappling. The sponsors of these engines of destruction may be pardoned for a certain lack of judgment if they fancied themselves on the brink of changes comparable to those which followed the rifled barrel and the machine-gun.

243. Whatever the pros and cons of the German policy which lay behind the operation of the flying bomb and the A-4 rocket, it is probable that, as the end approached, the German measures to stave off general defeat became less well co-ordinated and more involuntary. I have tried to show why I think it more than doubtful whether Hitler could have developed a decisive attack with the flying bomb and the rocket in 1944, whatever targets had been chosen. I have suggested that in fact he was confronted with the peremptory need of a sign which would show his followers that England was being attacked, and so mitigate to some degree the terror that was coming upon them. Where action is taken under forces of overwhelming compulsion there can hardly be a question of fastidious strategic judgment. None the less, in the complex and often tangled web of German strategy one important thread was missing. Though hidden at first by reason of the great number of aircraft deployed to lead off the German land campaigns, its absence became more obvious as operations went on. I refer to the German failure to think consistently in terms of air power. The Luftwaffe was allowed to run down, and no big enough measures were set

in train for its continuous replenishment, especially in respect of competent bomber crews. The result of this neglect was a progressive loss of air superiority, at first over the occupied territories and finally over the "living space" of Germany.

244. If, as Koller had said, the flying bomb and the A-4 rocket were to be regarded as a substitute for the strategic bomber force, the cardinal mistake was to suppose that these novel weapons could be used effectively in the absence of air superiority, which alone could have provided reasonable immunity from air attack. Only air superiority could ensure that the places where the missiles were stored, serviced, and fired, the crews who fired them, and the vehicles which carried them by road and rail would not be subject to systematic interference.

245. By the time the flying bomb and rocket campaigns were got under way, the Allies had gained a high degree of air superiority over all the areas from which the weapons could be fired. Hence we were in a position to conduct a counter-offensive at will, and without serious hindrance from enemy aircraft, wherever targets might present themselves and whenever the scale of attack by the Germans was sufficient to warrant the diversion of Allied bombers from their main task. Sometimes—as with the rail interdiction programme of the tactical air forces—operations conceived with the main task in view served a dual purpose, and no diversion was involved.

246. Moreover, this vital condition of air superiority, for which we had fought without respite since the Battle of Britain, enabled us constantly to improve the system of air defence whose application to new threats I have endeavoured to describe. Because we had air superiority we found ourselves free to adapt the system to novel circumstances and keep it in action day and night, with scarcely a rap from the German bombers not an hour's flying away.

247. The problems of air defence which have been described will not remain static. They may recur in new forms in the future. The scientific advances which the Germans used so spectacularly, if unsuccessfully, gave us a foretaste of hazards against which it is our business to provide. As science goes forward, and fresh discoveries lead to changes in the apparatus and methods of air defence, fertility in research and skill in engineering will provide better tools and weapons; but these are only raw materials of progress. What we need to do, above all, is to give rein to the qualities of mind and imagination which can take the growing mass of technical knowledge and mould what it brings forth to fit the shape of things to come.

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