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RESTRICTED

ROYAL AIR FORCE MONOGRAPH.

(First Draft).

BALLOON DEFENCES,

1914 - 1945.

Incorporating alterations made at the suggestion of Mr. H. Bateman, Balloon Development Establishment, Cardington - 29.9.45. (BDE/B.13/9. HB).

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BALLOON DEFENCES,
1914 - 1945.

THE DEVELOPMENT AND EMPLOYMENT OF BALLOON BARRAGES; WITH PARTICULAR REFERENCE TO THE WORK OF BALLOON COMMAND, ROYAL AIR FORCE.

INTRODUCTION.

Although this monograph is concerned primarily with the work of the Balloon Command of the Royal Air Force it is also, of necessity, very much affected by the history and development of balloons prior to the formation of the Command. There are two reasons for this; firstly, the decision to use barrage balloons as a defence against air attack depended largely on the production of a balloon that would meet the original Air Staff requirement for a high altitude balloon; second, the development of the balloon vis-a-vis the development of the aeroplane inevitably had a great effect on the subsequent policy adopted by the Air Staff.

The monograph will begin, therefore, in the year 1917 when balloons made their first appearance in this country in a defensive role.

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(1914/1939)

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BALLOON DEFENCES.

(Part 1 - 1914/1939).

CHRONOLOGY.

1914 - 1918.

The use of balloons as a means of anti-aircraft defence during the first World War.

1923.

New balloon policy formulated.

1924 - 1928.

Development and research.

1929 - 1933.

Balloon barrage for defence of London - first recommendations.

1934 - 1936.

Further development and research. First production of the L.Z. balloon. (March, 1936).

1936.

Further plans for the London Balloon Barrage.
First equipment ordered (May).
London Balloon Barrage approved by Committee of Imperial Defence. (July).

1937.

The formation of the London Balloon Barrage.
No. 30 (Balloon Barrage) Group formed. (17th March).
Formation of No. 1 Balloon Centre (4th October).

1938.

Opening of recruiting campaign (16th May) and formation of London Balloon Barrage squadrons.
Extension of balloon barrage to provinces approved by Committee of Imperial Defence. (July).
Formation of Nos. 2 and 4 Balloon Centres (4th August).
Emergency deployment of London Balloon Barrage (30th September).
Balloon Command formed. (1st November).
Formation of No. 3 Balloon Centre. (15th December).

1939.

Formation of No. 31 (Balloon Barrage) Group. (May).
Formation of No. 32 (Balloon Barrage) Group. (May).
Formation of No. 33 (Balloon Barrage) Group. (May).
Embodiment of Auxiliary Air Force balloon squadrons. (12th June).
Outbreak of War. (3rd September).

BALLOON DEFENCES SECRET

(Part II - 1939/1945)

CHRONOLOGY

1939

Further Expansion of Balloon Command.
Research and Development of Kites.
Further Research on High Altitude Balloons.
Formation of "M" Balloon Unit (June).

1940

Formation of Barrage at Scapa Flow (January).
Formation of No.34 (Balloon Barrage) Group (February).
Formation of Balloon Barrages at Havre and Boulogne (February).
Introduction of Barrage Control Operation Rooms (February).
Formation of Dover Barrage (July).
Introduction of V.L.A. Balloons (July).
Formation of Channel Mobile Balloon Flotilla (August).
Formation of Balloon Barrage for Alexandria (October).
Formation of Shore Servicing Stations (November).
Formation of "Free Balloon Barrage" (December).

1941

Bumper-Fitted German Aircraft (April).
Formation of Singapore Experimental Unit (April).
Expansion of Middle-East Balloon Barrages (June).
Womens Auxiliary Air Force Substition in Balloon Command (May).
Operation "Petard". (December).

1942

The "Kutonase" Cutter (January).
Formation of Balloon Squadrons for India (January).
Fundamental Change in Balloon Flying Policy (February).
Operation "Outward" (March).
"Baedecker" Raids (April).
Twin Cable Bomb Scheme (October).
Reduction in Balloon Command Establishments.

1943

Invasion of Sicily (July).
Preparation for "Overlord".
Preparation for "Anti-Diver" Barrage.

1944

Operation "Overlord" (June).
Operation "Anti-Diver" (June).
Formation of Scheldt Barrage (November).

1945

Balloon Command Stands Down (February).
Rhine Balloon Barrage (March).
Continental Balloon Barrages Disbanded (May).

SECTION 1.

BALLOON BARRAGES IN THE FIRST WORLD WAR.

"War in the Air" Vol.V. H.A.Jones. pp 66.

The idea of using balloons as a means of defence against air attack had been considered from time to time before and during the first World War.

R.N.A.S. Kite Balloon Training Manual, 1917.

The kite balloon for observation purposes was designed in 1894 by two Prussian Army officers, Major von Parseval and Captain von. Sigsfeld, and was intended to combine the attributes of the spherical balloon with those of the kite; the spherical balloon relying on gas content for lift and the kite on wind.(1) These two officers conceived the idea of designing a balloon which would not only be able to fly in winds precluding an ascent by a spherical balloon, but also be capable of taking operational advantage of such winds. Thus, the Drachen balloon was evolved; in shape, it was like a sausage, with a large air-filled rudder and "sails" of canvas placed well towards the stern on either side of the balloon. The rudder and observation car weighed the balloon down at the stern, while the sails gave dynamic lift and counteracted this gravitational pull. Tests at the National Physical Laboratory have shown that a balloon of this shape without sails will assume an angle of 53 degrees to the horizontal in a wind of 50 miles an hour, the angle being reduced to some 15 degrees with the fitting of sails under the same conditions.

In the autumn of 1915, Captain Caquot of the French Army turned his attention to improving the Drachen. His balloon was the first attempt at

/streamlining

(1) Before the kite balloon was invented, observation was only possible in light winds using a tethered spherical balloon.

streamlining, he thought he could obtain lateral stability by means of a large rudder which passed completely round the stern of the balloon on a longitudinal axis, while to secure vertical stability he contrived an arrangement by which the observer could move the weight of the basket forwards or backwards by means of a block and tackle.

The design was only partially successful, the lateral stability being insufficient, owing to the fact that the rudder was largely blanketed by the body of the balloon and unable, therefore, to come into play until the balloon had yawed out of wind to some extent. In a moderate wind the not very pronounced motion of the balloon was further reduced by the introduction of a small parachute tail, but in higher winds the motion was aggravated, while in a strong breeze it became very violent.

A further step in the evolution of the kite balloon was taken in England by the introduction of a parachute tail combined with four small parachutes attached to the body of the balloon. Experiments with inflated fins were also proceeding when Captain Caquot, in the summer of 1916, produced a new balloon characterised by three inflated fins set at an angle of 120 degrees to each other, and placed [illegible] forward of the extreme stern of the balloon. It was an immediate success, and the barrage balloon that was to become such a familiar sight in the British Isles during the years of the Second World War was fundamentally the same.

/German

German Balloon Barrages.

"War in the Air" Vol.V. H...Jones. pp 66.

A form of balloon and kite barrage was tried experimentally by the Germans in the winter of 1914/1915, but was not put into service until March, 1917; when a number of balloon detachments was formed to protect important industrial establishments. Balloons, or kites when the wind was strong, were let up to about 8,000 feet. The cables had thin wires attached (called side branches) carried by open wind sleeves. These barrages were expensive to maintain, but they were continued to the end of the War because their moral effect - both on the people they protected and on the crews of raiding aircraft - was considered to be great.

Italian Balloon Barrages.

On the Allied side a balloon barrage had been operating in Venice in June, 1917. Here, the Italians had seven balloon stations each with ten balloons, which were spherical in shape, The balloons were inflated at the beginning of each moonlight period and remained so while the possibility of a raid existed. When required the balloons were hooked on to cables on winches; these were attached to rafts which were towed at dusk to allotted points. The balloons were then let up to 10,000 feet, sited some 200 feet apart.

The French Balloon Barrage.

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Encl. 7B.
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The French also produced a balloon barrage[1] which formed part of the defence of Paris in 1918.

This consisted of a group of ten units

/placed

1. For further information concerning French barrage balloons see pp

placed about 650 feet apart, each unit comprising two small expanding balloons flying in tandem. The upper balloon flew at a height of 11,500 feet, and was linked to the lower balloon by a cable of 3.1 m/m diameter. The lower balloon flew at 6,500 feet from a heavier cable of 3.9 m/m diameter. The two balloons coupled together were let up from a small winch driven by a 10 h.p. engine.

The British Balloon Apron.

"War in the Air". Vol.V. H.A.Jones. pp. 67.

On the 5th September, 1917, Major General E. B. Ashmore, the General Officer Commanding, London Air Defence Area, put forward a scheme for a balloon barrage for the protection of the capital. Making reference, in his memorandum, to air raids which had occurred on the two previous nights, he said -

> "It is also shown that guns, defending machines, and searchlights as we have at present, are quite ineffective as a reply. This being the case it will, I think, be necessary to divert production from other objects to meet the new danger."

He went on to suggest a balloon barrage, proposing that between the balloons a cross cable should carry weighted wire streamers to form an "apron". He asked that as many observation balloons of the Caquot type as could be spared might be sent home from France and that orders should be given for at least one hundred small balloons of the type being used in Venice. He proposed to use the latter, each on a single light cable, over the waterways of the Medway and the Thames.

/(a) First

(c) First Trials.

"Air Defence" Maj.Gen. E.B.Ashmore, pp 55.

The scheme was approved by the Government and a few days later the first trial was carried out in Richmond Park. This was conspicuously unsuccessful.

On this occasion the apron consisted of five Caquot type balloons which were joined together at the top of the main cables by a cross cable on which was hung, at intervals of 25 yards, a series of weighted wire streamers. Unfortunately, a strong wind was blowing, with the result that one balloon broke away from its moorings, taking the others with it. Two balloon operators failing to let go of the handling guys of the last balloon also made a rapid ascent. One dropped from 1,000 feet over Richmond Park, the other from an immense height over Croydon.

"War in the Air" Vol.V. H.A.Jones. pp 68.

In consequence of this and other trials the apron was reduced to three balloons[1], and [redacted] on 22nd September an order was issued to all pilots to the effect that -

/Balloon

1. The final form of the apron consisted of streamers formed of light stranded wire cord 1.7 m/m diameter, 1,000 feet long which were suspended at intervals from a 3.5 m/m cord spanning horizontally the interval between the balloons and situated [redacted] 300/500 feet below them. The 3.5 m/m cord was 1,500 feet in length and its depth at the centre of the span was about 1,50[illegible] feet, giving a span of 1,460 feet. A 2 lb. sandbag attached to the end of each streamer kept it taut. Two of these spans carrying 40 streamers in all formed a complete apron and they were carried on three special 40,000 cubic feet balloons flown from 5.5 m/m cables. With this type of balloon, the apron could be lifted to 9,600 feet. Later the evolution of an entirely new design balloon, the "A.P." type, with a capacity of 70,000 cubic feet enabled the depth of streamers to be increased to 2,000 feet and the ceiling to 15,000 feet (estimated).

DESTROYED S.29169 Encl. 7B. 7/4/18.

> "Balloon aprons and other obstructions will be established on the line; East side of Lewisham - East side of Plumstead - one mile East of Barking - East edge of Ilford - East edge of Wanstead - North edge of Tottenham. No machines are to fly across this line during operations at a height less than 10,000 feet."

(b) Expansion of Aprons.

"War in the Air" Vol.V. H.A.Jones.

On the 6th October Major General Ashmore reported to the War Cabinet that the first apron was operating and that he proposed to proceed with a scheme for the installation of twenty such obstacles. These aprons would be let up nightly to 7,000/10,000 feet and would present a line of streamers 1,000 feet deep over a front of 20,000 yards.

Ibid.

The scheme for the provision of the aprons did not proceed as quickly as might have been hoped, but in May, 1918, nine were in action - eight flying North of the Thames and one South - and the General Officer Commanding was able to report -

> "These aprons are at present capable of attaining a height of 9,500 feet. Balloons of a new design are now in manufacture. With these it will be possible to raise an apron of an increased depth to some 12,000 feet. In my opinion the balloon aprons are an essential part of defence; to do away with them would have the worst possible effect. Our aeroplane patrols would have to cover all heights instead of a comparatively narrow zone, as at present. London would certainly be bombed from low heights at which considerable accuracy is obtainable."

By the middle of June the threat of air attack on London had virtually ceased, and the Air Council informed the War Office that

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the tenth balloon apron would complete the programme for the defence of London. No further aprons would be formed. Thus, when the Armistice was signed there were ten aprons operating. They had required 82 officers and 2,573 men to operate them. What had they achieved?

(c) Value of Aprons.

"War in the Air". Vol. V. pp. 116.

On the practical side there was one case of an enemy aircraft colliding with an apron. This occurred on the 28th January, 1918, when a Giant Gotha on its way to attack London flew into an apron near Chingford. The Gotha took the obstacle in its flight. It is not known how much, if any, damage was caused to the aircraft, but the apron suffered considerably.

"Air Defence" pp. 56.

In their effect on enemy morale, the aprons were more successful. In March, 1918, a report was made to General von Hoeppner, the Commander of the German Military Air Service, that -

> "the aprons had increased enormously... and added greatly to the difficulties of attack. If they increased and improved much more they would make a raid on London almost impossible."

The same month a German prisoner of war stated that the aprons -

> "were sufficient to keep all machines at their maximum height."

Major General Ashmore had no doubts as to their value. In a memorandum dated 22nd November, 1918, addressed to the Commander-in-Chief, Home Forces, in which he set out his recommendations for a peace time organisation, he stated -

/"The

"Air Defence" pp. iii.

> "The Balloon Apron system should be retained. This has been of great value in keeping enemy aircraft up to a certain height, and thus reducing the range of heights between which it is necessary for our machines to patrol. If the aprons do not exist, enemy aircraft can come at low altitudes from which better bombing results can be obtained, and, in these circumstances, to produce the same chance of meeting enemy machines, it would be necessary to double the number of our patrolling machines."

This view, it must be stated, may have been slightly prejudiced. The balloon aprons were General Ashmore's brain child. He defended them at all times. For example, in the last stages of the war when London had been free from air raids for some time, the Chief of the Imperial General Staff (General Sir Henry Wilson) suggested at a War Cabinet Meeting that the aprons could now be dispensed with and the men employed with them used for other purposes. This proposal was hotly contested by General Ashmore, and it is perhaps significant that the War Cabinet supported him and the aprons were retained.

(d) Disadvantages of Apron Schemes.

But whatever their value, the apron of three balloons had a number of major disadvantages. The balloons being all of the same size had equal lift. When they were let up to equal heights a great deal of the lift of the outer balloons was lost, since they each carried only a quarter of the weight of the span, while the centre balloon carried one half. On the other hand if all three balloons were let up to their equilibrium heights, with the load equally distributed, the centre balloon would fly lower than the other balloons, thereby reducing the

DESTROYED S.29169. Encl. 7.

/effective

effective height of the obstruction at the centre. Thus, there was a loss of height at the centre of each span due to its dip, while the limited length of the streamers made it possible for an aircraft to pass below the obstruction, while still maintaining a height of 7,000/8,000 feet above the ground. Nor did the aprons stand up to the weather. Even in light variable winds the aprons would sway, resulting in instability and entanglement of the streamers. In strong winds, if one balloon broke away, the others were obliged to follow suit. Thus, their flying time was restricted to favourable weather conditions.

Lastly, they were expensive to maintain, particularly in manpower, and it is probably for this reason that agreement was not forthcoming for General Ashmore's recommendation that the aprons should be retained as a peace time organisation. The section was disbanded, therefore, and the subject of balloons was not raised again in either the War Office or the Air Ministry until 1923.

/Section 2.

HIGH ALTITUDE BALLOONS.

Professor F. A. Lindemann's Views.

S.22930.
Encl. 1.

During the summer of 1923 the Duke of Sutherland, the Under Secretary of State for Air, had a conversation with Professor F. A. Lindemann[1] of the Clarendon Laboratory, Oxford, the main topic of which was the design of night bombers.

Professor Lindemann was convinced that -

> "all night bombing could be stopped by a kite balloon barrage unless steps were taken to protect the machines."

Advancing these views in a letter written a few days later, he suggested the types of balloon barrage our aircraft might encounter and outlined a method by which such obstacles could be overcome.

> "Providing the enemy confines himself to defending given towns or junctions by balloon barrages"

Professor Lindemann stated -

> "....he will not seriously interfere with operations....If the enemy decides to put up a barrage to protect a zone or even along a whole frontier, however, matters will be much more serious. Thus, a frontier as long, for instance, as that in the late war extending from Ostend to Bâle, could be closed by 1,000 cables and night bombing rendered impossible unless the Royal Air Force were prepared to sacrifice more than one machine in six in each raid."[2]

/Elaborating

1. Later to become Lord Cherwell, Scientific Adviser to the Prime Minister (Mr. Churchill).

2. Professor Lindemann calculated that for the Handley Page aircraft with a span of 100 feet, three balloon cables per mile of frontier would produce a ratio of impact of one in six. This view was contested by the Air Staff who considered three cables per mile would only produce a ratio of impact of one in eighteen.

Elaborating this idea, he went on to state that the production of 1,000 balloons capable of attaining a great height, even allowing for 33-1/3% wastage each year, was by no means impossible; the use of such a barrage, therefore, was to be expected. He appreciated that these balloons could not be flown in windy weather; but on the other hand -

> "bombing raids, at any rate long distance raids, can only be undertaken when the wind is moderate."

He suggested that there were only two ways of nullifying the effect of such a barrage; either -

> "by flying over it, or by protecting the aeroplane so that the chances of it being seriously damaged by flying into a cable are small."

The first of these methods was not considered practicable, since even during the war balloons could fly at 15,000 feet, and there appeared to be no reason to suppose that the use of larger balloons would not result in much greater heights. Even if the machine could fly higher than the balloons, however, its efficiency in attack would be seriously diminished since -

> "it would not be able to carry such a large load of bombs as it could if it were flying lower down."

Therefore, it was suggested that night bombers should be designed with a form of wire guard to protect them against balloon cables.

S.22930.
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Professor Lindemann's letter was duly passed by the Under Secretary of State to the Air Staff who were requested to examine the efficacy of balloon aprons. If Professor

/Lindemann's

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Lindemann's claims were substantiated it would then become necessary to go further into the design of the night bomber.

First Air Staff Views.

On 11th July, 1923, the day following the despatch of Professor Lindemann's letter, a meeting had been convened by the Chief of Air Staff (Air Chief Marshal Sir Hugh Trenchard) at which the question of the employment of balloons in anti-aircraft defence had been raised. The problem was discussed only in general terms, but the meeting did at least agree that it would be better to employ single balloons at, say, 12,000 feet for anti-aircraft defence, than to fly balloon aprons of the Ashmore type at 7,000 feet.

Some thought had been given to the subject, therefore, before Professor Lindemann's letter was received, but the position was still far too obscure for any conclusions to be reached. In fact, almost six months passed before the Air Staff were able to set out their first concrete proposals on the use of balloon defences. They realised from the outset that there were certain practical limitations to the extent to which balloon barrages could be used. They would be very expensive and extravagant in personnel.[1] Also, while the indiscriminate placing of a few balloons would have a certain moral effect on enemy pilots, it would not be sufficient to be

S.22930.
Encl. 12A.

/of

1. The Air Staff estimated that approximately 30 men would be required to handle a balloon capable of carrying a cable to 20,000 feet, and that to defend an area the size of London (i.e. a circle of 10 miles radius) 585 balloons would be required.

of very great value.

Air Staff Recommendations.

The Air Staff recommended accordingly that the most useful method of employing a balloon barrage would be :-

(i) In co-operation with defending aeroplanes.
To place a few short sections of balloon barrage in relation to a vulnerable area so that the avenues of approach for attacking aeroplanes would be limited.

(ii) In co-operation with anti-aircraft guns.
To surround with a balloon barrage certain small centres that could not be defended successfully by aircraft.

To be effective, these balloon barrages would have to fly at a height greater than the normal attacking height of night bombers, or if possible above their ceiling, and carry a cable that was heavy enough to bring down an aeroplane striking it.

The Air Staff, therefore, recommended that research should be made to ascertain :-

(a) The lightest cable that, when supported by a balloon, would bring down an aeroplane.

(b) The height to which such a cable could be carried by the present balloons in service.[1]

(c) If a balloon could be produced capable of carrying this cable to 30,000 feet.

(d) The number of personnel required to handle such a balloon

/(e)

1. Mostly observation balloons of the Caquot type.

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(e) The approximate cost of its production.

Having obtained the answers to these queries the Air Staff would then be in a position to judge if the provision of balloon barrages was feasible and, if considered so, it would then be necessary to enquire into the possibilities of fitting deflecting devices to aeroplanes.

S.23089. Encl. 1A.

Meanwhile, the War Office also had been thinking about making use of balloons and other stationary devices as a means of air defence. Having decided that the provision of, and research in, this form of air defence was the responsibility of the Air Ministry, they requested on 20th October, 1923, that the Air Council should furnish the Army Council with particulars of the prevailing state of balloon development, with special regard to the direction in which research was being pursued.

Research and Recommendations.

Ibid. Encl. 8A.

The Air Ministry in reply outlined the Air Staff's recommendations, adding that the War Office would be kept informed of progress but that at present no material for this form of defence was available.

The responsibility for research into the best types of equipment to form a balloon barrage to meet the Air Staff requirements rested with the Air Member for Supply and Research (Air Vice-Marshal Sir W. G. Salmond). In March, 1924, after some examination of the problem, he proposed to the Chief of Air Staff that any new scheme adopted should comprise single units consisting of a balloon of 3,000 cubic metres capacity capable of sustaining a cable at an altitude of 30,000 feet.[1] The cable

/itself

1. Some consideration was given to the French tandem scheme.

The cable itself should be tapered, being of 9.75 m/m diameter at the top and tapering down to 4 m/m at the base. This, together with a winch, would constitute a complete unit.

The standard balloon in service was of 2,000 cubic metres capacity and, flying on a tapered cable, could attain a height of 18,000 feet. It was expected that the same design of balloon with an increased capacity, namely, 2,500 cubic metres, would be capable of heights up to 25,000 feet carrying the same cable. To attain a height of 30,000 feet, however, an entirely new design was required in order to incorporate a system of expanding panels which would deal with the maximum expansion that would occur at this altitude.

The cable, too, would involve new construction, for while the present cable was satisfactory for 25,000 feet, it would not be so for the additional 5,000 feet required. The Air Member for Supply and Research further stated in his minute on the subject that -

> "no inherent difficulty is anticipated in designing either the balloon or the cable. If necessary, both could be produced in quantity in six months time."[1]

A new winch was needed, also, and this would take about a year to produce.

Before research went ahead, a decision was required whether or not the single unit scheme should be adopted, or the barrage should aim at a height of 25,000 feet or 30,000 feet.

/The

1. This optimistic statement, as subsequent events will show, considerably under-estimated the problems involved.

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The Chief of Air Staff agreed with these proposals, and instructed the Air Member for Supply and Research to go ahead with the 30,000 feet balloon.

Further Air Staff Discussions.

S.23089.
Encl. 14A.

Two months later, the Chief of Air Staff called a meeting to discuss balloon matters. He wanted both to know how research was proceeding, and to be kept fully informed of developments, so that as time went by he might be in a position to consider the best methods of using balloons.

The Air Member for Supply and Research stated that the whole question of production was centred upon the winch, but he thought one could be produced in three months and the tapered cable in a month.

The Chief of Air Staff considered that there was little point in designing a winch until it was known whether balloons were going to be utilised. He suggested that a drum to take the 30,000 feet of cable could be made in a month, set up on the ground, and attached to one of the power plants which existed at various stations. This would be able to haul the balloon down

The Air Member for Supply and Research said that there was no question of the balloon not going up to 30,000 feet attached to the ground by a cable, but the Chief of Air Staff was not fully convinced of this because he remembered that during the first World War, a balloon would not fly at this height without bursting. He wished to determine the effects of wind, the dangers of entanglement at various distances, and the angles of cables by

/experimenting

experimenting with two or three balloons. There were a number of other important questions to be answered; What was entailed in filling the balloons? How vulnerable were they on the ground? Where were they going to be put? To which stations should they be sent to carry out the experiments?

After considerable discussion the Chief of Air Staff finally ruled that five experimental balloons should be ordered. For a start these should be flown at 20,000 feet and no higher. Then, the height could be discussed and if everything was satisfactory they could be raised to 30,000 feet. No winches would be ordered until the balloons had been proved satisfactory. Lastly, Cardington was chosen as the station at which the experimental balloon flying should be carried out.

War Office informed of Balloon Barrage Scheme.

S.23196.
Encl. 20A.

The Chief of Air Staff evidently gave a good deal more thought to balloons during the next few days for on the 5th June, 1924, he wrote to Lieutenant General Sir J. F. Noel Birch, the Master General of Ordnance, outlining the position -

> "The balloon barrage of the last war was not really successful,"

he stated -

> "it certainly would not in its original form be worth considering for a future war, having regard to the improved performances of aircraft as regards the ceiling of bombing machines."

Having outlined the scheme for a high altitude barrage of single units, he continued -

/"This

> "This proposition may be susceptible to the development of otherwise undefended areas, and be a valuable auxiliary to the aircraft and the anti-aircraft guns employed in the defence of London. I want to make it clear, however, that I cannot envisage this scheme certainly in its initial stages - as being a substitute for aircraft and guns in defence; it can only be regarded as an auxiliary. And I must emphasize that the technical difficulties are considerable. No nation in the world has ever succeeded in sending a kite balloon up to 30,000 feet....in the war we thought we had done very well when we coaxed one up to 5,000 feet."

The Chief of Air Staff then went on to describe the research that was being planned, concluding his letter with a word of warning -

> "From the operational point of view the tactical employment of the balloons (if as efficient as the technical staff hope) will need the most careful handling. You will appreciate that the more they are an effective obstruction to the enemy aeroplanes, the more they will tend to limit our own aerial activity in certain spheres."

It was as well that the Chief of Air Staff did not share the optimism of his technical staff with regard to the construction of high altitude balloons, for not only did their designs proceed in a haphazard and inefficient manner, but what was finally produced was notable only for its lack of success.

/Section 3.

SECTION 3.

EXPERIMENTAL HIGH ALTITUDE BALLOONS.

The Air Ministry Balloon.

(a) Delay in Production and Design.

On the 6th October, 1924, the Master General of the Ordnance communicated with the Air Member for Supply and Research and asked about the present position with regard to the balloons. The following day the Air Member for Supply and Research informed him by letter that the Air Ministry were just completing their design and should be able to commence work within the next fortnight and some, if not all, of the five balloons to be constructed should be finished by the end of November.

S.23089. Encl. 25A.

> "We should, therefore, be in a position to give a demonstration in December",

hopefully concluded Air Vice-Marshal Salmond.

This hope was far from being fulfilled for when, in the middle of November, the Air Member for Supply and Research enquired from his kite balloon officer, Captain A. P. James, what progress was being made, he was informed to his great surprise that there was likely to be some delay in producing the balloons, owing to the difficulty of obtaining suitable fabric for their manufacture. This information, it should be added, was in complete contradiction of an earlier assurance by Captain James that the necessary fabric had been obtained.

Ibid. M.28.

Ibid. M.29.

The Master General of the Ordnance was duly informed of the delay, the Air Member for Supply and Research adding that -

/"the

"the requisite fabric has, however, now been obtained and we hope to make sufficient progress with the proofing to enable these balloons to be completed by the end of next January."

At this stage Captain James became indisposed and no further progress appears to have been made until the 16th December, when Group Captain P. M. W. Fellowes, the Director of Airship Development, informed the Air Member for Supply and Research that the design of the balloon was not, in fact, completely drawn up and that there were still details of its design to be decided upon. Group Captain Fellowes had put another officer, Mr. H. Wyn-Evans, in charge of the production of kite balloons, and proposed, in order to speed matters up, that a fresh policy should be initiated. His suggestions for this were -

Ibid. M.35.

(i) that an outline specification for a kite balloon to ascend to 30,000 feet should be drawn up at Cardington (this was being done).

(ii) that an order should be placed with Messrs. Spencer & Son, balloon manufacturers, to a design of their own.

(iii) that Spencers should be asked to forward their design to the Air Ministry on the understanding that this would not relieve Spencers of any liability.

(iv) that the time for the completion of the contract should be four weeks from the date of their receipt of a sufficiency of fabric to construct the balloon.

/(v)

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(v) that the design work for the Air Ministry kite balloon should continue and, when completed, recommendations could be made as to whether Spencers should be authorised to proceed with the construction of the remaining balloons to their own design or to that of the Air Ministry.

Ibid. M.36.

These proposals were agreed to and a week later a contract for two high altitude balloons was placed with Spencers.

But by this time the Air Member for Supply and Research was not satisfied that the designs for the Air Ministry balloon were as satisfactory as they might be, and instructed that an investigation should be made to clarify the position.

(b) Further Complications.

S.23089. Encl. 40A.

Captain James was still away, but contact was made with him on the telephone, and, as a result, the matter became more involved than ever. This was due to the fact that everyone, including the Air Member for Supply and Research, had been under the impression that the design had been produced by the Air Ministry. On the telephone, however, Captain James was understood to say that a Mr. Gibbs, a civilian, was the designer of the balloon.

Thus, the Air Member for Supply and Research now needed to know whether or not a design for the 30,000 feet balloons had been worked out by Air Ministry with or without the Royal Aircraft Establishment or the Royal Airship Works staff independently of Mr. Gibbs.[1] If this was so, why had Mr. Gibbs'

/design

1. The Experimental Kite Balloon Section was at the Royal Aircraft Establishment during the first part of 1924, but in August of that year transferred to the Royal Airship Works, Cardington.

design to be used?

Ibid. M.41.

The problem of Mr. Gibbs had also caused some concern to the Airship Finance Department which had discovered that an arrangement had been made by which Spencers were to build balloons from a design patented by him about October, 1924. Indeed, a model of the Gibbs balloon had been forwarded to the Air Ministry but could not be traced in Captain James's absence.

In any case, the main point was that it looked as though a private individual had obtained what was practically a monopoly of high altitude balloons, involving payment of public monies by way of royalties. But this was not all. Although the Chief of Air Staff had ruled that no winches were to be ordered at this stage, it appears that the Air Member for Supply and Research had decided that winches of a mobile nature would have to be provided. As specially designed winches were likely to take some considerable time to manufacture, a new design was rejected and on the 14th June, Captain James had stated -

Ibid.

> "We shall require some winches of the Sandycroft type. We have managed to trace the buyer of some of them, namely Mr. H. G. Gibbs, 19, Surrey Street, W.C.2."

As Mr. Gibbs was the gentleman already referred to, and with whom Captain James had clearly been in communication for some considerable time, it was no great triumph tracing him. Nevertheless, on Captain James's recommendation, four winches[1] owned by Mr. Gibbs were purchased in July for £3,600.

/Having

1. These winches were at the time lying dismantled at Scammell Works.

Having bought the winches the next step taken was to place a contract with Messrs. Scammell Winches, Ltd. to modify them to carry 28,000 feet of cable.[1] This was done in September, but by 30th January, 1925, the winches were not ready for delivery.

This, however, was a small matter, considering that the balloons were not yet manufactured. Nor did the question of suitable cables appear to have been settled, although Captain James had stated on the 6th October, 1924 -

Ibid.

> "the wire rope for the cable has been located and there will be no difficulty in providing the necessary lengths to make up the tapered cable decided on."

The R.A.W. Balloon.

(a) First Model Constructed.

While these investigations were being pursued, Captain James's successor, Mr. H. Wyn-Evans, had been getting down to work in a very much more efficient manner.

S.23089. Encl. 42A.

He had discovered that the design of the Air Ministry balloon, which was in hand at the Royal Airship Works, was the same as that on which Spencers were working. He therefore gave instructions for this work to stop and for an alternative design to be sought. Very soon, however, it became evident that there might be a hitch with Spencers over the question of suitable cable, and Mr. Wyn-Evans thereupon decided to revert to the so-called "Gibbs" design. By February, 1925, this had been carried out and a model was in process of construction at the Royal Airship Works. At the same time a full-sized balloon could be put in hand at short notice as all

/the

1. This length at best would only allow the new balloons to ascend to 26,000 feet instead of 30,000 feet.

the necessary dimensions and patterns were ready.

Nor had Mr. Wyn-Evans been inactive in the matter of the winches and cables. He had discovered that the cables referred to by Captain James consisted of five varieties of kite balloon cable, some of which included telephone core. The making up of a tapered cable from these did not seem to him either practicable or efficient, and he had obtained the assistance of cable manufacturers to produce a cable which would prove both lighter and stronger than that envisaged by Captain James. This would result in the Sandycroft winches (which at present had been modified to take 28,000 feet of cable and were virtually useless) being able to take the required amount of the new cable because it was of less mean diameter than that for which the winches had been designed.

Ibid. M.42.

Thus, on the 16th February, 1925, the Director of Airship Development was able to report -

> "The K/B position is now as follows:-
> 1 Balloon to be constructed at R.A.W. estimated date of completion 6 weeks.
> 1 Balloon to be constructed by Messrs. Spencer. Contract placed 14.2.25; date for completion 10 weeks, but it is understood Messrs. Spencer have proceeded with the work in anticipation of the contract being placed and they are being asked to say whether the date for completion can be improved. The Contract includes for a second balloon after completion of trials of the first."

All the main problems, therefore, appeared to have been solved.

Ibid. M.43.

By this time the egregious Captain James was out of the picture, but there was still a fly in the ointment in the person of Mr. Gibbs who apparently held the patents for the design of both balloons. Research by Mr. Wyn-Evans and

Ibid. Encl.42B.

/his

his assistants, however, had resulted in the discovery of a small four-lobe balloon which was constructed in France in 1917 and which was similar to the Gibbs design in every respect except that the original balloon had its lobes at 45 degrees to the vertical and horizontal, whereas Mr. Gibbs had specified the lobes actually vertical and horizontal.

Ibid. This led the Director of Airship Development to state -

> "I should therefore judge that the existence of this balloon would completely invalidate any of Mr. Gibbs' patents."

(b) Failure of the R.A.W. Balloon.

Ibid. Encl. 60A. By June, 1925 the R.A.W. balloon had been built, and, because of the urgency of the situation, old fabric, rigging and similar equipment available at the Royal Airship Works, Cardington, had been used for its construction. However, when the balloon was completed it was found that it did not take a satisfactory shape, and it was not practicable to attempt to make a flight. The Director of Airship Development therefore had no alternative than to report -

Ibid. M.47.

> "the R.A.W. balloon is a failure."

Disappointing as this may have been, Group Captain Fellowes did not attempt to sweeten the pill.

> "Judging from the results obtained with the R.A.W. balloon",

he added -

> "from the information I have at present, I think Spencers balloon must almost certainly be a failure."

The Group Captain was correct in his assumption.

The Spencer Balloon.

(a) First Trials.

Ibid. Encl. 60A. The Spencer balloon was delivered in August, /1925

1925, and when inflated had good shape at ground level.

The balloon's first two trials[1] were unsuccessful and it was modified by the inclusion of three transverse elastic curtains and two ballonets of approximately 20,000 cubic feet capacity

The third trial, carried out on the 20th November, was more promising. The balloon had been inflated with 126,000 cubic feet of hydrogen[2] on the previous day, and prior to the trial was topped up with a further 5,000 cubic feet. The rudder was inflated with air, but both fins were left deflated.[3]

Ibid.
Encl. 52A.

The balloon was walked out of the shed to the winch block by a handling party of 100 men. Here it was attached to 11,000 feet of 7-ton cable, which had been wound on to the winch in place of the 36,000 feet of high altitude special light cable. Gradually the balloon was manoeuvred into its flying position - this operation taking about thirty minutes to accomplish.

The balloon showed great stability and was let up to 3,000 feet at a medium speed, the combined static and dynamic lift proving so great as seriously to overstress and heat the brake

/drums

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1. The trials were carried out at Pulham.
2. The ground capacity originally specified was 120,000 cubic feet.
3. The fins subsequently were inflated by wind before the balloon started to rise.

drums. The balloon, when at 3,100 feet, rode vertically over the winch block, and the tension in the cable appeared to be of the order of between 2½ to 5 tons according to various estimates made by officers present at the trial. It was quite clear that ~~the remaining static lift of the balloon had been substantially exceeded, and that the dynamic or kiting lift of the balloon very largely added to its capacity for sustaining a heavier cable~~ there was considerable dynamic or kiting lift as the net static lift was only 1750 lb.[1]. The wind speed at 3,000 feet was about 25 m.p.h.

When the balloon was hauled down[2] it returned to its original shape as far as could be judged.

(b) Last Trial.

The fourth (and last) trial of the balloon took place on the 2nd December. The topping up on this occasion was carried out under the supervision of a representative of Spencers. 25,000 cubic feet of hydrogen was used. The balloon was walked out and manoeuvred in to the flying position in the same manner as on the previous occasion. On ascent it kept a good shape until it reached a height of about 500 feet when it began to yaw to port and became unstable. It then appeared to attempt to dive and the stern tilted up, but this was checked - presumably by a specially fitted suspension. A few seconds later the balloon became obscured by mist.

Ibid. Encl. 53A.

When some 3,150 feet of cable had been paid out, the cable began to jump badly and to lay itself along the ground. The winch was stopped immediately.

/A

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1. ~~This was 1,750 lbs.~~ The difference between the ground net lift, 22 cwt. and the weight of 3,000 feet of cable, 700 lbs.

2. The winch proved to be powerless to haul it down (2½ tons was its maximum hauling power) and the assistance of a tractor was necessary.

A part of the balloon was then observed to fall to the ground and after a few seconds a further part containing gas was seen to fall and bounce across country.

Thus ended the short career of the first Spencer high altitude balloon.[1]

The Aeronautical Research Committee.

S.23196. Encls. 61A & B. M.63.

While these trials were taking place the Air Member for Supply and Research had approached the Aeronautical Research Committee on the subject of high altitude balloons. The answer he received as a result of the Committee's examination of the problem was, in effect, that the Air Staff were asking too much in expecting a balloon to fly at 30,000 feet. The Committee pointed out that in determining the maximum height the balloon was required to reach, it should be borne in mind that scarcely any aeroplanes could carry a useful load of bombs to a height greater than 20,000 feet, and at the same time take up enough petrol to enable them to attack any objective at any considerable distance.

Ibid. Encl.61B.

"It seems exceedingly unlikely" continued the Committee's memorandum -

> "that any very considerable improvement on this figure will be obtained unless totally new forms of aeroplane motors are designed....from our knowledge of the present state of aeronautical science it would seem that a barrage up to 20,000 feet should suffice at least for ten years to come."

Ibid. Encl.61A.

The main problem, however, was the wind speeds /which

1. The cause of the accident appeared to the Director of Airship Development to be fairly definite, namely, an "inherent instability in the balloon due mainly to its high fineness ratio", i.e. that the fabric was not equal to the strain to which it had been subjected.

which were likely to be encountered at high altitudes.

"The wind speed at 30,000 feet"

observed the Committee -

> "might not infrequently be of the order of 100 m.p.h."[1]

The present balloons and cables could hardly be expected to stand up to this weather and the Air Member for Supply and Research suggested to the Air Staff that they should modify their requirements.

Ibid. M.62.

"For purposes of defence"

he stated -

> "we would wish to send the balloons up under all circumstances. This may well prove to be impracticable. I think, therefore, we cannot accept a lower wind speed on the ground than 15 m.p.h., which, apparently, represents 60 m.p.h. at 20,000 feet."

He went on to suggest, as a first step in tackling the problem, that the requirement for design purposes should be for a balloon to be able to resist a wind speed of 60 m.p.h. Thus, it would be necessary, at present, to restrict the maximum height required to 20,000 feet.

The Aeronautical Research Committee also suggested that the possibilities of a rigid type of balloon should not be overlooked as this had a number of advantages aerodynamically.

/The

1. ~~Since the air density at 30,000 feet is approximately one-third of that at 3,000 feet, the wind velocity at 30,000 feet is about three times as great as that at 3,000 feet. Therefore, a wind velocity of 30 m.p.h. at an altitude of 3,000 feet becomes 90 m.p.h. at 30,000 feet. At 3,000 feet the wind speed is about twice that on the ground. Thus, in the case of a wind speed of 90 m.p.h. at 30,000 feet, the ground wind speed would be 45 m.p.h.~~ This statement was based on experiments with free Met balloons.

The Air Staff Views.

Ibid. M.62.

This suggestion was not accepted by the Air Staff because of the difficulties of storing and housing large numbers of rigid balloons. The Air Staff did, however, agree to restrict their requirement to a minimum height of 20,000 feet. The next step, therefore, was taken by the Air Member for Supply and Research who convened a conference on the 11th March, 1926, at which Spencers were instructed to modify their design to increase the stability of their second balloon, and make it capable of carrying a cable weighing 4,000 lbs. to a minimum height of 20,000 feet in wind speeds up to 60 m.p.h.

High Altitude Kites.

S.23808. M.1.

As it became evident that the first Spencer high altitude balloon was likely to be unsuccessful it was, perhaps, natural that the question of kites should be raised. It was first mooted by the Director of Airship Development who suggested that experiments should be carried out with high-flying kites which, he suggested, could be used either as a substitute for or as an accessory to the high altitude kite balloon system of defence. He had been in communication with the Aeronautical Research Committee on this subject, and while awaiting their reply, he sought the Air Member for Supply and Research's sanction to carry out the experiments. The Air Member for Supply and Research in turn asked the Air Staff for an opinion. The suggestion was received with some interest by the Air Staff who appreciated that the kite had one distinct advantage over balloons, in that it could not be

/easily

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Ibid. M.4.

easily shot down. But before they would commit themselves on the subject they wished to know:-

(i) The size of kite required to lift to 18,000 feet a cable strong enough to damage an aeroplane on impact.

(ii) The minimum wind in which it could rise from the ground.

(iii) The minimum wind in which it could support the cable at 10,000 feet and 18,000 feet.

(iv) The maximum wind in which it could fly at the above heights.

Ibid. Encl. 16A.

These queries were placed before the Aeronautical Research Committee who stated that it was extremely unlikely that kites of any size would reach an altitude of 18,000 feet in England, and that even if this height were attained it would only be on rare occasions. Practically the maximum height ever reached in the British Isles was 10,000 feet, the minimum wind speed required being approximately 35 m.p.h., and even this height had only been achieved by using more than one kite.

Ibid. M.20.

These observations resulted in the Air Member for Supply and Research informing the Deputy Chief of Air Staff (Air Vice-Marshal Sir John Steel) that he did not propose to spend money on kite defence unless the Deputy Chief of Air Staff pressed him to do so. The Deputy Chief of Air Staff in reply agreed that this was not necessary, and the Aeronautical Research Committee were informed that it was the intention of the Air Staff to postpone consideration of the matter until further progress had been made with the high altitude balloon.

Ibid. M.21
Ibid. Encl.19A.

Research and Development 1926/1928.

The next two years, 1926/1928, were spent

/almost

almost entirely on research and design. Two balloons were built; one, known as the R.A.W. "Z.1." was produced by the Royal Airship Works at Cardington. The other, built by Spencers was known as the Spencer "Z.1." In addition, some consideration was given to an Italian designed high altitude balloon to which the Americans were giving their attention.

The R.A.W. "Z.1."

Neither of these balloons was successful. During "preliminary" experiments with the R.A.W. "Z.1.", a slight accident occurred to one of the fins when the balloon was flying at a low altitude. This resulted in loss of control and the balloon was destroyed by fire. It had, however, flown very satisfactorily for about two hours, and the same design with minor modifications was used for the R.A.W. "Z.2." which was ultimately to prove the first successful high altitude barrage balloon to be designed in England.

S.22930.
Encl. 27A.

The Second Spencer Balloon.

The second Spencer balloon was ordered in 1926, but it was not until March, 1928 that it was finally accepted, and only then after a number of concessions had been given to Spencers with regard to the strength of fabric, and other important points.

An air inflation test was carried out on the 27th April, 1928, during which several internal rubbers broke when the volume of the balloon corresponded with that which it would have when flying at 15,000 feet. The test, therefore, was stopped. As there was no suitable

/winch

winch available from which to fly this balloon, it was kept air inflated for the next sixteen months. During this time several more rubbers broke although under only a small tension.

It was considered advisable, therefore, for the Aircraft Inspection Department to carry out a second inspection of both the rubbers and the fabric. This was done and the inspector rejected the rubbers[1] throughout the balloon.

Reports of tests on two samples of fin fabric showed that the strength of one was nearly 20% under specification, and the permeability of the other was at least 450% greater than the specification, which made its further use inadvisable. Some of the tests on the main envelope fabric showed that the strength was some 10% below the original specification, and should the rubbers be renewed the factor of safety of the balloon at the specified height would still be well under what was considered a safe figure. Nevertheless, it was ruled that the balloon should be repaired and re-rigged, and it did, in fact, finally attain a height of 16,500 feet. The design was not considered satisfactory, however, and no further balloons of this type were ordered.

Ibid.
Encl. 55B.

American High Altitude Experiments.

S.671646/26.
Encl. 1A.

The Americans did not subscribe to the view that a protecting barrage must carry a cable strong enough to inflict damage. The U.S. Army Air Service began experimenting with high altitude balloons in 1925 with the idea that their moral effect, in

/conjunction

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1. 520 in all.

conjunction with other weapons, might be of value in defending small but vital targets from air attack.

On the 1st February, 1926, the Air Attaché at Washington reported (to the Director of Air Intelligence, Air Ministry) that the U.S. Army Air Service Engineering Division had been testing at Wright Field, a 20,000 cubic feet balloon known as the "A.P." (AVORIO PRASSONE)[1] and that a height of 13,000 feet had been reached. The cable used was stated to combine lightness and strength to a remarkable degree. Further enquiry showed that this balloon was of single ply fabric and of the three gore dilatable type, the longitudinal gores expanding against rubber chords during ascent, giving an increase in volume from 15,000 cubic feet to 25,000 cubic feet at ceiling. Three air-filled lobes stiffened by fabric diaphragms provided for stability. Reliable details about tension and breaking stress of cable were not forthcoming, and data available indicated that the "A.P." was merely a fair weather craft intended to be flown to height for moral effect and its performance did not approach the British Air Staff's requirements for a balloon which would fly at 20,000 feet in a 60 m.p.h. wind lifting a cable strong enough to withstand the impact of an aircraft.

Avorio Prassone Balloons.

(a) Experiments in England.

The Air Staff, however, were evidently /willing

1. Named after Lt.Col. Avorio and Dr.Prassone, the designers for a private Italian firm named "AEROSTATICA AVORIO" of Rome. These experts visited England to demonstrate their balloon in October, 1927.

willing to learn from this Italian source of experiment - and made contact with the "A.P." firm.

S.23813. Encl. 15A.

Early in March, 1926, three balloons of the "A.P." design were ordered from Spencers with the intention of using them for trials of an apron-type barrage. The first, "A.P.50", was received at Cardington during July and, on 19th August, was flown to 5,000 feet for a weather test. Next day it was sent to 13,250 feet in a wind of 40 m.p.h., 17,600 feet of cable being paid out. Unfortunately, the cable parted near the winch and the balloon, which was damaged, was returned to Spencers for repair.

The second balloon, "A.P.51", was delivered to Pulham on 1st September, 1926, and two days later flown to 14,500 feet in no wind, 16,000 feet of cable being paid out. The third balloon, "A.P.52", arrived early in October and a number of trials were carried out with "A.P.51" and "A.P.52" carrying an apron from which hung dummy explosives on streamers.

(b) Apron Experiments, 1926 - 1927, with Avorio Prassone Balloons.

Ibid. Encl. 22A.

The repaired "A.P.50" was returned during December and on 1st February all three "A.P." balloons were flown to nearly 11,500 feet supporting two apron spans each 1,500 feet long carrying ten streamers with dummy explosives. The idea was to see the amount of drag caused by the spans and streamers and ascertain whether the streamers were likely to foul the main cables.

(c) Apron Scheme Abandoned.

S.22930. Encl. 55B.

From ground observation and photographs the balloons did not appear to be pulled together appreciably by the weight of the aprons, but the

weather conditions at the time were particularly good, and the results could not be considered as conclusive evidence of the practicability of the apron scheme.(f) After further consideration, the Air Staff decided that the moral effect of a balloon and its cable was all that was required, as the apron would not be sufficient to disable aircraft flying into it. Certain experiments of flying aircraft into a wire net which were carried out at Farnborough led to this decision.

Ibid. Encl. 28A.

The three balloons were deflated during March, 1927 and two were sent for mooring mast tests, one going to the Royal Airship Works and the other to Egypt.

(d) The Avorio Prassone System.

S.23813. Encl. 45A.

During the following September, a further "A.P.", an expansible type known as the Avorio 1400 M3 arrived at Pulham. Lieutenant Colonel

Ibid. Encl. 49A.

Avorio, Doctor Prassone, the designers, and Chief Tecnic Zenobi arrived from Rome shortly after to supervise the acceptance trials at Pulham.

Although the Avorio 1400 M3 was designed as an observation type to carry a load of 220 lbs. in the basket to over 7,000 feet, it incorporated a new idea for high altitude design - that of providing for the expansion in gas volume by a combination of ballonet and elastic gores. The Spencer and R.A.W. high altitude balloons used no ballonet thereby saving weight and large external volume at low altitudes. They relied on elastics which, when used alone, made the balloon flabby, of poor shape and awkward at low heights. Moreover, uniform distribution of

(f) In any case had the dummy bombs been armed, all the crew would have been blown up when handling them at the difficult height when the lower part of the apron was first touching or arriving at the ground /gas

gas was difficult to maintain without the use of surge curtains.

Avorio's system was intended to put an end to these difficulties; the elastics served to maintain satisfactory pressure and shape up to 3,000 feet, the ballonet taking care of the expansion for the next 10,000 feet or more.(1)

(e) Early Ideas on Protection from Lightning Stroke.

Another feature was the method of protecting the balloon from lightning stroke. In the British balloons this was done by the careful bonding and earthing of all metal parts. The Italian designers took quite the opposite view and eliminated all metal parts as far as possible, covering the many wires with fabric, and ignoring the certainty that moisture through condensation or rain would largely neutralise the insulation.(2) Colonel Avorio answered all queries about this point by stating that of 400 balloons flown in all weathers in Italy, none had been damaged by lightning. The Cardington Technical Staff remained sceptical of the extent to which this system would protect balloons in the moister climate of England. This early theory is interesting in view of the amount of research that had to be done on the protection of balloons from lightning in the early days of large barrages.

A further unusual fact came to light during these tests. The balloon, when flying 500 yards from the Pulham D.F. Station, caused an error of from 9 degrees to 15 degrees in bearings taken on aircraft crossing the Channel, whereas the British balloons, flying often at the same distance had produced no such disturbance - a hint of the effect /which

(1) It is doubtful, however, whether 13,000 feet could have been achieved.

(2) The suggestion of insulating the balloon from the cable was put forward again in 1914-18 by a Committee under the chairmanship of Sir Oliver Lodge.

which barrage balloons and cables were to have on G.L. sets during the second World War.

(f) Trials of the 1400 M3 Avorio.

S.23813. Encl. 46A. Before acceptance, the expansible Avorio had not only to carry the specified load to height, but was to be proved stable in winds of 33 to 45 m.p.h.

Ibid. Encl. 49A. On its first trial on 3rd October it attained 8,100 feet carrying the 100 Kg. in the basket and, on the 13th October, Flying Officer M. H. Steff and Flying Officer J. H. Leach made an ascent to 2,600 feet in order to observe the behaviour of the balloon closely. This proved to be satisfactory.

After waiting eleven days for a wind of 33 m.p.h. to develop, Colonel Avorio and the other Italian representatives decided to return to Rome, authorising the Air Ministry to carry out the final test of stability in high ground wind.

Ibid. Encl. 51A. When this took place on 19th October, the balloon behaved well enough to pass requirements, but proved less stable than the previous "A.P." balloons.

Ibid. Encl. 55A. The balloon was duly housed in a hangar at Pulham where it rapidly lost gas because the wooden valve warped. The balloon was therefore deflated. It was considered that this showed -

> "that an insulated valve is not able to withstand the English climate and therefore the Italian method of insulating each part of the balloon against electrification cannot be used in this country."

Ibid. Encl. 75A. This Avorio was inflated again during 1928, but as experimental work was being concentrated on the two high altitude balloons,

/Spencer

Spencer "Z" and R.A.W. "Z.2.", nothing more than maintenance work appears to have been done on this balloon until it was finally deflated in November, 1932 and written off.

Air Staff Requirement Changed.

S.22930.
Encl. 55B.

The failure of the R.A.W. "Z.1.", the Spencer "Z.1." and the "A.P.'s" to fulfil their requirements influenced the Air Staff to review the situation and, on the 13th August, 1928, Air Commodore C. R. Freeman gave the Air Staff views to the Air Member for Supply and Research.

> "I realise there are many technical difficulties in producing a balloon capable of reaching a height of 30,000 or 20,000 feet with a cable strong enough to bring down an aeroplane".

he wrote -

> "and there is a natural inclination for us to be satisfied with a lighter cable, to forego material effect and to trust moral effect."

He went on to state that unless a certain amount of material damage was inflicted by this form of defence, the moral effect on enemy pilots would soon disappear.

> "The demand for some form of static defence such as a balloon barrage",

continued Air Commodore Freeman -

> "will be felt more and more as years go on and as technical aids to flying, such as automatic pilots and direction finding wireless, are developed and perfected. The enemy will operate on days and nights which would now be considered unsuitable. Fighter activities are limited by visibility and through lack of it they may be considered impotent, and for the destruction of the enemy we shall have to count on static defences..... Although our requirements were framed a considerable time ago I see no reason for altering them or for giving up the idea of trying to bring machines down. It may, however, help

/if

if we agree in the first place to limit the height to 15,000 feet, i.e. half our original requirement and we will be prepared to accept this if a balloon can be produced. But at the same time if we accept this reduced height for balloons with cables strong enough to bring enemy machines down, I should like another balloon with a light cable developed to reach a greater altitude."

The R.A.W. "Z.2."

Thus, the next balloon to be built by the Royal Airship Works was not required to fulfil such stringent conditions as its predecessor.

S.23844. Encl. 46B.

Based on the R.A.W. "Z.1.", which had already shown that it was fundamentally correct in design, the "Z.2." was constructed and tested at Cardington in 1931 and 1932. The original design represented an attempt to reach 15,000 feet[1] in a wind speed of 50 m.p.h. and was regarded as an intermediate step towards the development of a balloon which would reach 20,000 feet in a wind of 60 m.p.h. at that height.

Ibid. Encl. 6E.

The R.A.W. "Z.2." on trial on 26th June, 1931, held about 80,000 cubic feet of hydrogen of purity[2] 92.8% giving a net lift of 2,576 lbs. The ballonets were initially inflated to a pressure of 10 m/m, and in later trials the tail cone and the rudder bag were also inflated before ascent, thus bringing into effect the stabilising influence of the fins, and preventing yawing in gusty conditions during the early stages of its flight.

(a) Design of R.A.W. "Z.2."

The "Z.2." had a number of unusual features

1. The designed altitude had to be modified to 14,000 feet during construction in April, 1930 because of a contractor's mistake in supplying fabric all of one bias, so that certain envelope panels had to be reversed and doped, thus adding to the weight of the balloon. On trial 14,000 feet was reached or exceeded on eight occasions.
2. A purity of 94% gave a net lift of 3,300 lbs.

features; a pointed nose to prevent "blowing in"; a surge curtain dividing the gas envelope into fore and aft compartments to prevent surging of the gas and to improve the stability; three intercommunication ballonets fed by one scoop, and a special tail cone, copied from Italian designs, communicating with the rudder. Newly designed cam-operated gas and ballonet air valves were used, and most of the metal parts of the balloon were electrically bonded and earthed through the flying cable, and a lightning conductor system was incorporated.

(b) Trials of R.A.W. "Z.2." at Cardington.

During the twenty-six trial flights at Cardington, photographs both from the air and the ground showed that a good envelope shape was maintained at each height in all winds. Although a large balloon, its steadiness was reflected in the relatively small ground crew of forty men required to handle it. It reached the modified design altitude of 14,000 feet with ease, and on one occasion the altimeter recorded 15,900 feet with a gas purity of only 92.5%. In general, it fulfilled its designer's expectations: the new design valves both for gas compartment and ballonet worked to his satisfaction - and the special tail cone system proved a complete success.

In addition, these trials afforded valuable experience in the use of tapered flying cable and of winch design details - particularly that of the grooving of surge drums. The effect of use and weathering of the fabric was the only disappointing factor. Apart from this, the "Z.2." proved a distinct step forward in high altitude balloon design.

/Thus

S.23844.
M.40.

Thus, on the 26th July, 1932, the Superintendent, Royal Airship Works was in a position to report to the Air Ministry that a high altitude balloon had been produced which could be relied upon to fly steadily at over 15,000 feet in winds of 30 m.p.h. His technical staff, therefore, were in a position to proceed with the design of a balloon with a minimum ceiling of 20,000 feet.

Ibid.
Encl. 38A.

/Section 4.

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SECTION 4.

BALLOON BARRAGE FOR DEFENCE OF LONDON.

Recommendation by Air Officer Commanding-in-Chief.

While these experiments and trials were being carried out, the Air Officer Commanding-in-Chief, Air Defence of Great Britain (Air Marshal Sir Edward Ellington) had enquired in July, 1929, what progress was being made in the production of balloons suitable for barrage purposes.

S.22930. Encl. 23A.

After pointing out that a balloon barrage was of considerable value during the last war,[1] he stated that he was of the opinion -

> "that a similar type of balloon would still be of use to the defence in view of the fact that it has been established by meteorological methods that clouds are below 2,000 feet over London on more than 50% of the days of the year. I recommend, therefore,"

he concluded -

> "that it should be accepted in principle that a balloon barrage forms part of the defence of London and if, when it becomes necessary to raise this Command to a higher degree of readiness for war, an improved type of balloon capable of operating at greater heights has not been designed, a barrage of the old type could be provided."

Ibid. Encl. 29A.

The Air Staff in reply outlined the progress being made in the design of high altitude balloons.[2] They stated further that although it was agreed that a balloon barrage should form part of the defences of London, it was necessary to wait for the

/development

1. There was always a considerable divergence of opinion concerning the value of the London balloon apron. It will be recalled that Air Chief Marshal Sir H. Trenchard did not consider it "really successful." - See pp.

2. At this time the R.A.W. "Z.2." was being constructed.

development of a satisfactory type of balloon. When this had been done the organisation of such defence could be worked out in detail and it would be possible to decide upon the location and number of balloons required.

Ibid. Encl. 37A.

The subject was not raised again until the 2nd February, 1932, when the Air Officer Commanding-in-Chief, Air Defence of Great Britain (now Air Marshal Sir W. G. Salmond) stated that experience gained from air exercises during the past five years conclusively pointed to the vital necessity of some form of balloon barrage as a defence against low flying attack.[1] This would be supplementary to the fighters and anti-aircraft defences of the London area.

Limitation of Operational Height.

The Air Officer Commanding-in-Chief was of the opinion that the time had now arrived to formulate a definite policy, and suggested that the height of the barrage should be limited to 9,000 feet,[2] and that it should consist of a number

/of

1. There were several reports of the effectiveness of low flying attacks during the Air Exercises of 1931. Para.12 of the A.D.G.B.reports of these Exercises states: "In paragraph 3 (b) of Air Officer Commanding Wessex Bombing Area's report he comments on the low raids carried out. For reasons of safety these were not permitted below 500 feet. I agree with the Air Officer Commanding that such evidence as the Exercise afforded makes it seem likely that really low raids by high speed bombers are likely to prove successful....the only means at present available for dealing with such raids effectively appear to be two seater fighters, though possibly some form of balloon barrage would prove a deterrent to this form of attack."

2. This limitation of height was suggested not only because a low altitude balloon barrage would suffice as a defence against low level attack, but because Air Marshal Salmond, until recently Air Member for Supply and Research, realised only too well the difficulties of producing a suitable high altitude balloon.

of balloons on single cables. He suggested that experimental work on the design of the balloons and cable should be put in hand at Cardington. Meanwhile, subject to the approval of the Air Staff he proposed to investigate, in conjunction with the Air Officer Commanding, Fighting Area, the details regarding the spacing required between balloons and the areas which it was considered necessary to protect with a barrage.

Ibid. Encl. 42A.

The Air Staff did not commit themselves with regard to the Air Officer Commanding-in-Chief's proposals, but they did say that any suggestions regarding the spacing and the location of the balloons would be received with interest.

Memorandum on Use of Kite Balloons for London Defence.

Ibid. Encl. 46A.

At the same time, the Superintendent, Royal Airship Works, was instructed to prepare a memorandum on the question of employing kite balloons in the air defence of the London area. This memorandum was forwarded to the Air Ministry in September, 1932.

Ibid. Encl. 55B.

For the purpose of the memorandum a line[1] of defence of ten miles was considered; this, it was suggested, could be covered by thirty balloons, each spaced 600 yards apart. Five hundred and fifty officers and other ranks would be required to operate the balloons which would be divided into ten units, each of three balloons. The initial cost of the barrage was quoted tentatively at £450,000. Other points, such as the methods of hydrogen supply and

/the

1. This would cover the area from Croydon to Woolwich or Ilford to Dartford. Other defence lines suggested were Ilford to Enfield, Enfield to Wembley, Wembley to Kingston, Kingston to Croydon.

the need for mobile balloon winches, were carefully considered and suggestions for the most economical way of using them were put forward.

Hardly had this memorandum been received at the Air Ministry when the Air Officer Commanding-in-Chief, Air Defence of Great Britain, forwarded his proposals for a balloon barrage for the defence of London. Briefly, he suggested that the balloons should cover four sectors of London,[1] giving a fairly continuous barrage from the East, South-west and South. If the balloons were spaced every ½ mile, a minimum of seventy-two balloons would be required.

Ibid.
Encl. 57A.

For economy in organisation, training and administration the formation of three balloon squadrons was advocated. Each squadron was to consist of three flights of eight balloons each, with one[2] balloon in reserve; the flights being sub-divided into two sections of four balloons each. A squadron leader would command each squadron, the whole organisation being in charge of a wing commander. The squadrons would be placed under the Air Officer Commanding, Fighting Area, for the purpose of training and operations, and all training carried out for the time being at Cardington.[3]

/As

1. A reconnaissance of London for an ideal balloon barrage was carried out by Wing Commander R.G.B. Small, Officer Commanding, R.A.F. Station, North Weald. He had found some 720 sites in Greater London from which balloons could be flown.
2. Not until the London Balloon Barrage had been flying for some time was it realised that wastage of balloons, mainly as the result of weather conditions, would be on a very large scale.
3. This station had all the facilities for housing balloons and the necessary hydrogen plant for inflating the balloons.

As a preliminary step, the Air Officer Commanding-in-Chief suggested the formation of one flight of eight balloons which could be used for experimental purposes.

Conference with Air Defence of Great Britain.

Ibid. Encl. 65A.

As a result of these memoranda, a conference was held at the Air Ministry on the 28th October when the question of balloon defence was discussed. The main point under consideration was whether the high altitude or the low altitude balloon barrage was the best method of defence.

High Altitude Balloon Barrages.

When the proposal for a high altitude balloon barrage was conceived and the development of a suitable balloon was initiated, service aircraft were not equipped with parachutes. The introduction of parachutes was generally recognised as likely to lead to a reduction in the moral deterrent to enemy aircraft flying at heights above 2,000 feet.

If balloons were placed a quarter of a mile apart, as the Air Officer Commanding-in-Chief, Air Defence of Great Britain, had suggested, the chance of an aircraft of 50 feet span striking one of the balloon cables would be about 25 to 1, assuming that the aircraft crossed the barrage line at right angles, without drift, at a height less than that of the balloons, and that the pilot did not see the barrage in time to take avoiding action.

It was the opinion of the conference that, in the case of aircraft equipped with parachutes, the moral deterrent would be small, whilst the physical deterrent would be almost negligible. Indeed,

/the

the opinion was expressed that incoming bombers might prefer to pass through such a barrage, if by doing so they could hamper the opposing fighters.

It was agreed, therefore, that balloons would have to be sited very much closer[1] together.

Another factor against high altitude balloons was that by night, and in conditions of poor visibility by day, fighter aircraft would be unaware of their position in relation to the balloons. Again, these balloons could not be raised or lowered at speed to conform to tactical requirements and weather conditions, and once up they would remain a hindrance to the defence and a vulnerable target to the enemy.

In these circumstances, the balance of the opinion of the conference was that the advent of parachutes and the added experience which had been gained in the problems of home defence had profoundly altered the situation and that high altitude balloon barrages were no longer worth while.

This view was strengthened by an examination of figures for cost of manning.[2]

Low Altitude Balloon Barrages.

The essence of the discussion that ensued on low altitude balloons was that they should fly in the lowest cloud strata or with a maximum height of about 5,000 feet. This would reduce /the

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1. The question of the balloon cables, particularly those of high altitude balloons, becoming entangled if the balloons were sited too close together appears to have been overlooked completely.

2. A.D.G.B's proposal of 72 balloons was estimated to involve:
   (i) Total strength to operate and maintain barrage - 30 officers and 1,200 men.
   (ii) Annual expenditure - about £500,000.
   (iii) Capital expenditure on formation - about £1,500,000.

the vertical area of search for defence fighters; increase the effectiveness of the defence against low flying attack; or provide fixed defences for targets of special importance such as Woolwich Arsenal or the Beckton Gas Works against accurate low bombing. Moreover, the low altitude balloon barrage had a number of material advantages as compared with the high altitude type in that it was easier and cheaper to produce and could be more mobile; balloons could be spaced more closely and raised and lowered with greater speed; and it was thought that coal gas[1] could be used to inflate the balloons.

In short, the general opinion of the conference was that the low altitude barrage was the more promising of the two.

Views of Air Officer Commanding-in-Chief, Air Defence of Great Britain, on Low Altitude Barrages.

Ibid. Encl. 71A.

On the 16th April, 1933, the Air Officer Commanding-in-Chief, Air Defence of Great Britain (now Air Marshal Sir Robert Brooke-Popham) informed the Air Ministry that after further consideration he had come to the conclusion that the low altitude balloon barrage was the best form of balloon defence. He considered that the first unit to be formed should be sited so that it would constitute a defence to the London Docks. Here, the unit would form a nucleus about which the remainder of the barrage could be grouped at a later date.

Ibid. M.88.

The Chief of Air Staff (Air Chief Marshal Sir Edward Ellington) was not at all sure that balloon barrages were really necessary, but the

/Deputy

1. Coal gas was readily available anywhere in the London area and this, it was suggested, would greatly increase the mobility of barrages and would reduce cost.

Deputy Chief of Air Staff (Air Marshal Sir E. R. Ludlow-Hewitt) pointed out that the question of reintroducing balloon barrages had been already adequately considered by the authorities most concerned - Air Defence of Great Britain and the Air Ministry - and he felt that the Air Staff were justified in making a start. After pointing out that France and Poland had organised balloon barrages in existence and that Italy, Germany and the United States were studying the question, Air Marshal Ludlow-Hewitt went on to say -

Ibid. M.89.

> "There would appear to be little doubt of the value of balloon barrages, if properly used within reasonable limits. I do not think we can afford to ignore the value of the contribution which the balloon barrage may make to the defence of London.
> Moreover, the subject has been neglected for so long that we are in danger of getting seriously behindhand in development. I feel, therefore, that the time has come when we should study our requirements more closely and embark upon a modest experimental and research programme."

He proposed, therefore, that a low altitude balloon barrage section should be formed in 1934, consisting of three balloons with one in reserve, to be manned by two officers and some fifty other ranks. The estimated cost of this would be in the region of £17,000.

Ibid. M.91.

This proposal was agreed to in principle by the Chief of Air Staff and an estimate[1] of the time

/required

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1. The estimated dates of completion of the different stages of provision of equipment were :-

Receipt of proofed fabric at the Royal Airship Works.....	May, 1934.
Completion of first balloon for test.....	October, 1934.
Completion of preliminary test of first balloon to check rigging, scoops, etc.....	December, 1934.
All four balloons completed.....	February, 1935.
Cardington's trials completed....	April, 1935.

required for the various stages of the programme was worked out. It was arranged that the personnel comprising the unit should be based on Cardington, but as the balloons and winches would not be ready until 1935 they were not established until that year.

/Section 5.

SECTION 5.

THE FRENCH LE TOURNEUR DILATABLE BALLOON.

S.22930. Encl. 140A.

On the 14th June, 1935, the Air Attaché in Paris reported to the Director of Operations, Air Ministry, that a French Army balloon enthusiast, Captain Le Tourneur, had developed a remarkable dilatable balloon[1] of only 14,650 cubic feet capacity which was expected to have a ceiling of 20,000 feet. By using tandem balloons he had already reached this height and by employing a new balloon fabric and special cable which had recently been perfected, he anticipated that 26,000 feet would be attained without difficulty.

The Dilatable System.

This had been achieved by employing the dilatable system, in which, at low altitudes, the envelope is held pleated by an internal rigging of elastic sandow-cords. With the expansion of the gas at height, the elastic stretches to nearly four times its original length, with the result that the balloon tends to assume a circular cross-section thus increasing its capacity and obviating the necessity for valving gas.

Tactical Uses of the Le Tourneur Dilatable Balloon.

Ibid. Encl. 140A. Air Attaché's Report.

When the Le Tourneur balloon was flying in still air, the cable was somewhat slack and the maximum altitude was 18,000 feet; as the wind rose the cable became taut and 20,000 feet could be

/reached

1. This balloon was made of exceptionally light rubberised silk. It took just over an hour to reach its maximum altitude.

reached. It was considered that this slackness was a distinct advantage as there was little chance of its breaking and the tendency would be for it to wrap itself round parts of an aircraft.

By surrounding an objective with single balloons spaced 600 feet apart, it was claimed that their "wandering" would effectively prevent any aircraft from penetrating the defence up to 20,000 feet at night with complete certainty and by day would give partial security. Alternatively if they were more closely spaced at 450 feet apart but "staggered" it was claimed that the defence was virtually perfect and could be realised at a fraction of the cost of a comparable measure of defence by anti-aircraft gunnery.

The balloon was a comparatively fair-weather craft in that the maximum wind speed in which it could be operated was 49 m.p.h. compared with the 60 m.p.h. required by the Air Staff. But the outstanding performance for such a small ground capacity balloon indicated at once that the French balloon service had made very considerable advances since 1918, not only in design of fabric and cables, but also in winches. The winch used with the Le Tourneur balloon had a haul down speed of over 3,000 feet a minute in an emergency, and it was clear that the French attached great importance to this as a method of clearing the air quickly to permit defensive aircraft to pass through the zone.

Interest Aroused at Cardington.

Ibid. Encl. 141B.

This good performance and exceptionally high hauling-in speed greatly interested the

/Superintendent

Normally the balloon could not be hauled down safely at a high speed; in fact frequent stops were essential so that the rubber shock cord could recover. This winch speed was primarily intended for a special observation balloon in which the after rigging could be dispensed with in an emergency & the balloon hauled down rapidly (but unsuitably) nose down.

Superintendent, Royal Airship Works, and he requested that arrangements might be made with the French authorities for Mr. H. Bateman (the designer of the K.B."Z.2.") and Flight Lieutenant C. W. Harrison (the officer in charge Kite Balloon Section at Cardington) to visit France to obtain first-hand information of the developments and to discover whether the troubles experienced with elastic cords had been overcome.

The fundamental difference in the conception of the function of a balloon barrage was also a matter that required investigation. For while the cable of the British balloons was designed to be taut and strong enough to damage an aircraft on impact, the French cable was light and slack with the object of fouling the propellor or wrapping itself round some part of the aircraft. In fact a new question of policy had been raised about cable strength.

Visit of Balloon Experts to France.

Altogether, three visits were made by Air Ministry representatives to France during 1935/1936 to investigate the performance of the Dilatable balloon - now called "H.1." by its manufacturers, the Ariel Company.

S.36978. Encl. 1B.

The first visit was made by Mr. H. Bateman of the National Physical Laboratory and Flight Lieutenant C. W. Harrison, in November, 1935.

Ibid. Encl. 29A.

The second visit was made by Dr. Roxbee Cox of the Royal Aircraft Establishment, Farnborough, and Flight Lieutenant Harrison, in May, 1936.

Ibid. Encl. 40A.

The third and last visit was made by Wing Commander G. B. A. Baker, M.C. of the

/Directorate

Directorate of Technical Development and Flight Lieutenant Harrison, in July, 1936.

Ibid. Encl. 1B. On the first occasion the visitors inspected the high altitude balloon at Chalais Mendon and found that the French claims could be substantiated and that they had indeed produced, in the Dilatable, a balloon of small ground volume (15,000 cubic feet) which would carry a light cable to 20,000 feet, a performance which could not be matched by any of our existing balloons of much larger capacity. They also made a tour of the research department of the French Government Establishment at Chalais Mendon, and were particularly impressed by the extensive equipment of the fabric laboratory and the amount of research being done on silk and rubber.

On a visit to the works of the Zodiac Company they were able to examine one of the tandem barrage balloons which still constituted the standard French barrage defence.

Ibid. French Advances in Hydrogen Plants.

An important discovery was that hydrogen was being made by a high pressure process which was a decided improvement on the process used in this country. Gas of very high purity (over 99%) was being produced under pressure for delivery direct to hydrogen cylinders, thus eliminating the danger and cost of storing and compressing. Further advantages were that the same quantity of hydrogen was produced from about half the quantity of a much lower grade of silicol than was used in this country. This reduced the cost of the chemical by 75%. The quantity of water needed was also less and the plant could be

/operated

operated with salt water without loss of efficiency. Compared with this very simple and efficient high pressure system which had been developed by the Societé des Gas Industriels de Provence, the hydrogen plants in this country designed over twenty years before were obsolete and far more costly to run.

No flying trials were witnessed on this occasion.

Results of French Research.

Ibid. Encl.29A. The second visit was to the offices of the Ariel Company and a very comprehensive discussion was held with the principals on the French view of balloon protection by light high cables.

The state of refinement in design and materials, superior fabric, lighter rubber and stronger cable than those employed in this country had only been reached by years of specialised research with laboratory equipment much in advance of that in Britain. The fact was that British expenditure on balloon research and lighter-than-air development in general had been cut to a minimum. For example, research on fabric was carried out by one man, Mr. J. N. H. Dyer, the Scientific Officer at the Directorate of Scientific Research, Cardington. Clearly Mr. Dyer's unaided work could not be expected to compare with the results obtained in the highly organised French laboratories. Thus the obvious next step was to obtain samples of the light fabric, rubber and cable used in the Dilatable and get the Rubber Research Association and the cable industry to attempt to produce similar or better materials for British use.

/The

The knowledge of this very striking improvement in balloon design achieved by the French did not give rise to any alteration in the Air Staff balloon policy but the Deputy Chief of Air Staff (Air Vice-Marshal C. L. Courtney) on 29th February, 1936, did recommend that their technique should be applied to our own balloon construction policy with the object of increasing efficiency and reducing cost.

French Faith in Defence by Light Barrage Cable.

Ibid. Encl. 29A.

The French had great faith in the ability of the light high altitude balloon cable to bring down enemy aircraft and at the same time affect the morale of bomber crews. They had carried out no actual experiments to test the effectiveness of such a cable but quoted the fact that from March, 1918, when barrage balloons began to be used to protect Paris, until the end of the War, in 15 attacks by 60 to 70 aircraft, only one of these penetrated the defence. This was destroyed. Further, they cited previously accidental collisions of aircraft with cables. These fell into two classes:-

(i) Collisions with observation balloon cables.

(ii) Collisions with "protective" (i.e. barrage) cables.

They had deduced from this that when an aircraft hit an observation cable, the cable usually broke and the aircraft was often able to land safely, but should it impact a Kite Balloon defence cable, the cable would drag and the aircraft stall and crash. They did not appear to regard seriously the suggestion that bomber speeds would be much greater than their 180 m.p.h. Marcel Bloch and considered

1 i.e. the balloon to be at its maximum height and plenty of cable paid out.

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300 m.p.h. a bomber speed very much of the future. They seemed confident that their cable could deal with present possible bomber speeds and that should the enemy attack balloon protected areas they would lose aircraft at such a rate that after five weeks attacks might well cease altogether. It was intended to protect Paris with 250 balloons; 1,500 balloons were being put in reserve for defence of factories, towns, etc., while industrial towns were to buy their own balloons.

Ibid. Encl. 29A.

The French authorities were quite willing to make arrangements by which the British could construct the balloon and its equipment, and a tentative proposal had been made that a Dilatable should be bought for testing at Cardington. Discussing business arrangements, it was learnt that the cost of a balloon was 135,000 fr. (= £1,350) and that of a single cable 35,000 fr. (= £350). The Ariel Company could not supply winches but suggested that if the winch could be manufactured in England for £750, a complete unit, with a spare cable could be produced for about £3,000. It was probable that a balloon could be delivered in about four months. But as the large French orders and 48 balloons which had been ordered for the defence of Brussels were likely to absorb the available fabric output, the firm would prefer that Great Britain should make the balloons under licence. The Company were prepared to grant a licence to the British Empire and to give every possible assistance to the firms entrusted with the manufacture.

Ibid. Encl. 29A.

/Superintendent

Superintendent, Royal Airship Works, Recommends Purchase of French Balloon.

S.36978. Encl. 30A. 8/6/36.

Thus, when submitting the official report on this visit to the Air Member for Research and Development on 8th June, 1936, the Superintendent, Royal Airship Works, strongly recommended that arrangements should be made to purchase -

(a) One balloon, together with specifications and working drawings.

(b) Two cables with specifications, and

(c) A silicol plant for hydrogen manufacture, with specifications and working drawings.

His object was to avoid the delay that would necessarily take place in the development of similar materials by British manufacturers. He suggested too that if the British Government decided to obtain a licence for making the balloon and manufacture was undertaken by private interests, control should remain under the Government and the firm should not be allowed to exploit the design commercially except to meet the requirements of the Dominions and Colonies. Cables and silicol plant would come under a different category and arrangements, he suggested, should be made for suitable firms in this country to conclude their own arrangements for manufacture.

Ibid. Encl. 33A.

The Air Member for Research and Development accepted this suggestion and instructed the Director of Technical Development to order the balloon, cables and silicol plant.

Flying Trials of Dilatable "H.1." at Toulon.

Ibid. Encl. 30A.

The Ariel Company had promised to send an invitation to Air Ministry representatives to attend the air manoeuvres at Toulon and witness the flying trials of the "H.1." high altitude

/balloon

balloon. On this, the third, occasion when Flight Lieutenant Harrison and Wing Commander Baker visited the Ariel Company, Chalais Meudon, and the French Marine Airship Station at Cuers-Pierrefeu, near Toulon, they saw the official flying trials. As the new design balloon had already been accepted by the French Government as the standard defence balloon, the trials were not acceptance trials but army tests.

Ibid. Encl. 40A.

Ibid. Encl. 40B.

The trials took place on the night of 22nd July, 1936, in a light ground wind and clear sky. The stabilisers inflated with air as soon as the balloon left the ground. The cable used was specially fine tapered six strand cable flown from an ordinary Delahaye winch.

The flight was carried out under the supervision of an expert from the French Air Ministry and, in order that as much information as possible should be gleaned about the balloon, a recording barograph, inclinometer, thermometer and atmospheric pressure gauges were fitted just above the point of attachment, as well as a special Richard anemometer which transmitted wind strength tick signals to a wireless loud speaker on the ground. These instruments weighed some 40 lbs. In addition, a searchlight was provided to keep the balloon under observation during ascent; the ascent was stopped every 500 metres when the tension and angle of the cable were checked and cross-checked; and altitude was checked by two naval range finders.

The balloon reached 16,400 feet with 22,000 feet of cable paid out, the wind speed on the balloon ranging from 30/40 m.p.h. It was very steady, the envelope retaining a good shape on landing, and appearing easy to handle near the ground, at least

/in

in the light wind prevailing.

The failure to reach the designed height of 20,000 feet was explained by the light winds at altitude and the particularly warm state of the air above 14,000 feet. The instruments carried showed an unusual temperature "inversion" which gave a reading of 26 degrees centigrade at altitude rather than the usual 18 degrees centigrade. This high temperature of upper air had reduced the available lift but, in view of the conditions, it was considered that the altitude attained was an amazingly good performance for so small a balloon. It was reasonable to suppose that a series of trials in more favourable conditions would show even better results.

Meanwhile, the order for one "H.1." balloon had been placed by the Air Ministry and, on the 31st July, 1936, M. d'Almeida, a Director of the Societé "Ariel" wrote to our Attaché pointing out that the delivery of a single balloon without guarantee of further orders to the fabric makers made it necessary for them to consider it as the delivery of a prototype and charge the same for it as they had done for the original to the French Government, namely, £8,000. They included two cables for this price and the supervising services of their Engineer, M. le Commandant Le Tourneur.

Ibid. Encl. 41A.

Trials of the Le Tourneur "H.1." at Cardington.

The Air Ministry agreed to these terms and the balloon arrived at Cardington on 5th November, 1936, where it was measured for the construction of a model for wind tunnel

S.23813. Encl.238A.

/experiments

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S.~~600438/37.~~
Encl. 1A.
Ibid. Encl. 3A.
Ibid. Encl. 7A.

experiments at the National Physical Laboratory. It was gas inflated during January, 1937, making three flights, and an altitude of 20,400 feet was reached. Further flights were carried out in March and April, during which latter month it broke away and was damaged. Repaired, and now styled K.B./H.L./8, it was flown at Cardington during August, 1937 in connection with Richard anemometer and W.T. reception tests. During November it was used at Manston for Directorate of Scientific Research operations and in April, 1938, at Lakenheath for impact tests where it broke away again and burst in the air. Repaired and re-inflated in July, 1938, it was sent once more to Lakenheath in August for more impact tests. The balloon itself seems to have spent its last days playing the role of an "Aunt Sally", but the wind tunnel model provided a basis for variations which were of help in the design of the H.Z/1 and 2, balloons which were constructed at Cardington during 1938 and intended to reach 10,000/15,000 feet. The time and money spent on this balloon were not altogether without value, for in April, 1937, the Superintendent of the Royal Aircraft Establishment wrote to the Air Member for Research and Development suggesting that four plans for solving the problem of the high or medium altitude balloon barrage should be tried. These would compete with the Ariel balloon and yet not infringe its patents. He thought that the polygonal internal rigging of the Ariel could probably not be bettered in economy of weight and ease of attachment to the fabric, and suggested that this design had been anticipated in the British Spencer balloon,

Ibid.
Encl. 43A.

Ibid.
Encl. 53A.

DESTROYED
~~S.600438.~~
Encl. 15B.

3
S.41329.
Encl. 1A.

/so

so that only the fin arrangement of the French balloon could not be copied. New type fins could be developed from wind tunnel tests.

Air Staff Views on French Policy.

9/3/37. Despite the French views on the definite advantages of their high balloon and its official adoption in France, the Air Staff were not convinced. As the Ariel principals remained adamant in their demand for royalty rights for production of the Ariel balloon in England, the Air Member for Research and Development gave instructions early in 1938 that a British alternative should be produced, without copying the French ideas.

S.41201. Encl. 2A.

Thus, although there was no radical change in the Air Staff policy and no acceptance of the French idea of high altitude slack cables, research on high altitude balloons[1] continued alongside that of the development of the lower barrage balloons.

S.22930/11. Encl. 76A. The question of a high altitude barrage was raised again by Mr. Winston Churchill who suggested, at the 18th meeting of the Air Defence Research Committee in 1938, a barrage of 35,000 feet strung as a necklace along the coast from the Isle of Wight to the Tyne; the balloons flying at intervals of 170 yards. The Research Department of the Air Ministry, in consultation with Sir Henry Tizard's

/Committee

1/2/37. 1. The production programme at Cardington on 1st February, 1937, was in fact:-

Production of 40 L.Z. balloons.
Production of 12 training balloons.
Production of high altitude balloons, the latter on lesser priority.

Committee, were invited to set out the pros and cons of this proposal. By the 16th January, 1939, in a memorandum to the Air Defence Research Committee they came to the conclusion that:-

"(a) The development of a really high 35,000 feet armed barrage presented technical difficulties that made it essentially a very long range project.

(b) High balloons were likely to be a danger to our own fighter protection and might easily be shot down by special enemy aircraft or cut away by enemy bombers long before the balloons could be close-hauled.

(c) To attain 35,000 feet would prove too costly for its strategic value and a medium 10,000 feet to 15,000 feet barrage to augment that at 5,000 feet would be more worth while."

There was an obvious sense of impending war in the minds of the Air Staff and the need for the provision of the lower cable protection[1] was paramount. Thus, as time was pressing, the immediate aim had to be the supply of 450 first-line balloons to operate at 5,000 feet.

/Section 6.

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1. This proved a good decision since the doubts about the efficacy of high barrages were confirmed by the practical experience of the French before the War was very old. A letter dated 29th November, 1939, from the Air Attaché, Paris, includes this report from the officer commanding the balloon defences in the area of the First French Army -

Air Attaché's Report.

"General Bienvenue said that the war had taught that the idea of a high balloon barrage as compared with our preference for a low one had been proved to be a wrong one, since at height the thin French tapered cable could not stand the strain and serious entanglement between cables took place. For this reason, a medium altitude barrage was all that could be successfully operated."

SECTION 6.

RESEARCH, 1934 - 1938.

Trend of Research.

S.22930/11. Encl. 53A.

During these years research on balloon barrage problems became more systematic. In particular, attempts were made to produce lethal effects with light cables, and it became clear that it was necessary to review the British plan of lifting heavy cables with large balloons.[1]

The main programme of development in 1937 - 1938, therefore, was towards a lethal barrage of moderate height which would neutralise the effects of the armoured leading edges and cable-cutting devices of enemy aircraft. And although it might fly only to 4,000 or 5,000 feet, it was precisely at this lower level that our fighter and gun defences were least effective; a static last line of defence, which would be unaffected operationally by fog or ice was, in consequence, most urgently needed.

/The

1. The following data point to the fact that a much higher ceiling could be reached with smaller and more manageable balloons carrying a lighter cable.

Type of Balloon.	Theoretical Ceiling. Ft.	Capacity.	Wt. of Bln. in lbs.	Strength of Cable at upper end Tons.	Wt. of Cable. lbs.	Total Wt. Tons.	Remarks
Spencer.	20,000	320,000 at altitude.	6,460	9.5 max.	7,100	6	Failed in flight.
Z.1.Cardington.	20,000	234,000 Non-Expansible.	3,300	9.5 max.	7,100	4½	Failed in flight.
Z.2.Cardington.	Reached 16,000	120,000 Non-Expansible.	2,180	8.0 max.	3,100	2½	
French Ariel.	17,400	Ground 15,000 Altitude 26,000	480	1.0	400	0.4	Has flown to about 20,000 ft.
Enlarged type of French Ariel.	30,000	Possibly 100,000					

The problem was to ensure that this thinner cable obstruction should be deadly.

The line of research was turned to impact tests in order to obtain information about lethality against aircraft, both protected and unprotected by anti-cable devices. Three new types of balloons were proposed:-

(i) A small balloon to carry a strong cable to 5,000 feet.

(ii) A balloon of about 30,000 cubic feet capacity to reach a ceiling of 20,000 feet against unprotected aircraft; alternatively, to lift a much stronger cable to a lower height against protected bombers.

(iii) A very high altitude balloon aiming at 30,000 feet - the capacity of this to depend on the weight of cable and the lethal devices required.

Concomitant Winch Development.

Meanwhile it became patent that if any considerable number of balloons had to be flown as a barrage, a much more specialised and more mobile form of winch would be needed than the various Scammell types used for experimental work.

S.23813. Encl. 236B.

Unmounted Scammell winches were fitted with Ford V8 engines by Messrs. Wilds of Birmingham and trials with these engines and various types of radiator were made in 1936 at Cardington while flying L.Z.2.

E.P.M. 121 (36).

An initial order for 47 winches was placed with Messrs. Scammell for delivery before the end of 1936. These winches, complete with their power units, were to be mounted on the standard Crossley fire-tender chassis.

Wilds offered a winch especially designed for mass production at a considerably lower price than Scammells and this was formally adopted for the new barrage. This winch could be powered with a Ford engine.

/The

S.22930.
Encl. 157B.

The L.Z. (Low Zone) Type Kite Balloon.

The first kite balloon designed for low altitude work was known as the Low Zone Kite Balloon (L.Z.). Each balloon was to be flown from its own mobile winch to 5,000 feet. A distinctive new feature of these balloons was the strength[1] of the cable which they were designed to carry.

The balloons[2] were designed and built at the Royal Airship Works, Cardington, Mr. H. Bateman of the National Physical Laboratory acting as consultant. The design was evolved from the Single Observer Type Kite Balloon and was the same in capacity and in the construction of the envelope and stabilisers. The aim was to construct a similar 20,000 cubic feet balloon which would fly satisfactorily at moderate heights without the steadying effect of basket and observer.

Special Features of the L.Z. Type.

The aim of design was simplicity and robustness, and the question of rapid and cheap manufacture and maintenance of large quantities of the balloon was not overlooked. For instance, only four kinds of proofed fabric were used; the rigging and patches were of universal design, easily replaced, and the fewest possible types of cordage were used.

The first four balloons were built at Cardington, and L.Z.1. was given very thorough flying

/trials

1. At a conference held at Air Ministry on 24th July, 1933, it had been decided that the breaking strength was to be not less than 3½ tons, this being considered a suitable size to withstand impact from certain types of aeroplanes with good prospect of damaging them and with the smallest chances of damage to the cable and balloon.

2. Principal particulars of the L.Z:-

Volume: 19,150 cubic feet.
Length: 62.8 feet.
Maximum diameter: 25.2 feet.
Weight: 565 lbs.
The balloon was designed for operation in winds up to a maximum of 60 m.p.h.

trials at the end of 1934, while the three other balloons were transferred to Larkhill in May, 1935 to form a barrage flight.

Shed Trials.

Air inflation tests showed the envelope to be of good shape and to hold pressure well. The side gas valve of the ballonet operated type required to be set after being fitted in the balloon. On gassing, the purity maintained indicated that the rubber proofing of the envelope and the gas valve seating were satisfactory.

Flying Trials.

L.Z.1. was given over 60 trial flights in all weathers at Cardington from October, 1934 to August, 1935. This long period was necessary to discover and eliminate the cause of a troublesome defect in the rudder - a deformation of the leading edge with a flutter of the trailing edge. Both were cured ~~eventually by reducting the profile~~ after the trouble was detected in wind tunnel tests, by a slight reduction in the peripheral length ~~shape~~ of the rudder. ~~The tyre stabilisers were subsequently modified~~ The two upper fins (of the same size) were similarly modified so that all three could be manufactured rapidly.

L.Z.1. reached its designed ceiling of 5,000 feet with ease and on one occasion attained 6,000 feet with a gas purity of only 93.3%. It was found to handle well near the ground even in gusts to 25 m.p.h., the handling party of untrained men never exceeding fifteen. It nosed into wind quickly giving low cable tensions[1] and was steady in flight. Rapid hauling down trials /showed

1. The maximum momentary cable tension recorded in strong and gusty wind was 25 cwts. Average tensions were between 7 and 15 cwts. which were well within the designed cable factor of safety of 2.5.

showed little tendency for the nose to blow in, indicating that the ballonet worked well.

Field Trials of Three L.Zs. at Larkhill.

Operation tests flying L.Z.2, 3 and 4 together at Rollestone Camp provided the following information:-

S.22930. Encl. 166B.

(i) Balloons, when stationary, could be safely flown at 200 yard intervals, but when under way flying at about 500 feet, it was undesirable for the winches to be closer together than 400 yards; otherwise there was risk of entanglement.

(ii) An L.Z. balloon, even with a purity as low as 86%, would attain an altitude of 5,000 feet. Purity was well maintained and if it fell to 87%, it was possible, by letting up to 5,000 feet, then hauling down and re-gassing, to keep up an average purity of 91% without difficulty.

(iii) The hydrogen consumption was reasonable; it averaged one bottle (= 370 cubic feet) a day and, as topping up required 20 men to bed down, this was most conveniently done every third day. One new type tube of 1,250 cubic feet capacity would be sufficient for three or four days.

Ibid. Encl. 178A.

(iv) The balloons could be towed[1] by the winch quite steadily at an air speed of up to 60 m.p.h., the best towing height in open country being 300 feet.

(v) The most practical cable speed both for "letting out" and "hauling down" proved to be 400 feet a minute, the time taken to pay out from 500 feet to 5,000 feet averaging eleven minutes.

(vi) It was essential to use trained personnel to handle the winches.

(vii) Balloons could be moored out satisfactorily in winds up to 75 m.p.h.

/L.Z.

1. Considerable importance was given to the question of whether balloons could be towed safely at fast road speeds - the idea being that in this way balloon sections, at a few minutes' notice, could be closed up to form a dense barrage at the anticipated point of attack.

L.Z. Balloons go into Production.

The results of this exhaustive series of trials were thus very encouraging. The Royal Airship Works had produced a successful design with simple maintenance and low hydrogen consumption, and the flying cable, winch and chassis were also considered satisfactory. This type was accordingly approved in March, 1936 for manufacture in quantity. Messrs. Dunlops contracted to make the next fifty L.Zs. 5 to 54 to these specifications, and approval was given in July for the construction of a further twenty, Nos. L.Z. 55 to 74 by the Royal Airship Works. In April the first L.Z. operation handbook was prepared and sent to the Director of Technical Development for Air Council approval before issue to the service.

S.23813. Encl. 227B.

Ibid. Encl. 231A.

Ibid. Encl. 235A.

Ibid. Encl. 227B.

L.Z.2. was used for flying cable impact tests at Portland during June, 1936, and design drawings were prepared in July for the experimental flying of an L.Z. in tandem with a Single Observer Kite Balloon.

Ibid. Encl. 231B.

During October, officials and employees of the Dunlop Company visited the Cardington workshops for instruction in the various stages of balloon manufacture, so that by the end of 1936, quantity production of balloons for the low barrage had been set in motion.

Ibid. Encl. 236A.

L.Z. Development Designs.

By May, 1937 it seemed that provision for a low altitude barrage protection for London had been made. The Royal Aircraft Establishment impact experiments indicated that it could probably be made lethal too. It was

S.41339. Encl. 4A.

/then

then realised that the chief factor limiting the extension of such a barrage to other localities was a question of money and manpower. Although the L.Z. was intended only for low altitude, it was not a small or inexpensive balloon (about 20,000 cubic feet) and a crew of at least ten was required to handle it; organisation and hydrogen were costly.

It was considered that there would be no difficulty in producing a much smaller and more handy balloon of 5,000 cubic feet capable of flying at 5,000 feet with a lighter cable. ~~It was suggested that this relatively cheap barrage~~, not necessarily lethal, might augment the London low altitude L.Z. barrage and be extended to other areas.

Although this balloon was primarily intended for training purposes it was suggested that a number of them,

Ibid.
Encl. 12A.

Report by Chief Superintendent, R.A.E.

In August, 1937, steps were taken to estimate the volumes and blowing-away speeds of balloons of L.Z. shape when lifting cables of various strengths - 2½ tons, 1¾ tons and 1 ton - to 5,000 feet.

It was learned from the Director of the Meteorological Office that at 6,000 feet, winds of over 80 m.p.h. were of very rare occurrence in South-east England and the South Midlands, so that a cable of rather more than one ton breaking strength would suffice to hold the balloon, while a 2½ ton cable would ensure that the cable would be strong enough to cut into the leading edge of an aircraft.

The L.Z./A.

On the basis of these data, a conference held at the Royal Airship Works on 25th August, decided that, with refinements in design, a cotton

/fabric

fabric balloon of 11,500 cubic feet could be adopted, carrying a 2¼ ton cable and that this would damage aircraft travelling at 150 m.p.h. ground speed. Further impact trials were to confirm this. By September, the design of the 11,500 cubic feet L.Z./A. balloon was well advanced and approval had been given for the construction of four of these at Cardington. The type later became obsolete because practical experience of stormy conditions showed that an even stronger balloon and cable were needed, and the 20,000 cubic feet L.Z./C., carrying a 3" [illegible] cable, superseded L.Z./A.

The L.Z./B.

DESTROYED
S.600438/37.
Encl. 48B.

A second modification, the L.Z./B. of which four were also ordered in 1938, was an attempt to construct a 11,500 cubic feet low barrage balloon on the expansible cord system, but difficulties were encountered with friction between the rubber cords and the envelope, and excess pressures, and the first sample L.Z./B.1. burst in the air at 3,000 feet during its trial flight. Although the cause of the failure was not solved and a different design of gore - a double expanding one was fitted to L.Z./B.2. - these balloons, with an expansible portion in lieu of ballonet, did not seem likely to prove a success for low barrage purposes.

Ibid.
Encl. 55A.

Ibid.
Encl. 57A.

The L.Z./C.

Ibid.
M.54.

A third type, the L.Z./C. - also intended as a development and replacement type for the original L.Z. model - was designed in October, 1938. By this time the Air Staff had

/decided

SECRET

decided that, owing to the difficulty of handling balloons near the ground in high winds, it was desirable that the future types should be capable of flying in any weather conditions other than the exceptional gales likely to occur only once or twice a year. These balloons were not to exceed the 20,000 cubic feet size and so become unmanageable.

Ibid. Encl. 53A.

Ibid. Encl. 57A.

The L.Z./C. was an endeavour to meet this increased breaking-away speed and to incorporate also non-metallic rigging as a protection against lightning stroke.

Ten balloons had been destroyed by lightning at Cardington in September, 1937 and a small expert committee had been investigating the whole question of the effect of electrical atmospheric disturbances on moored balloons. As a result it was decided to replace steel rigging with non-metallic rigging; but considerable research was necessary before patches which would take the non-metallic rigging were evolved. Non metallic fabric was also used.

S.P.M. 159 (37)

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S.600438/37.
Encl. 60B.

/Section 7.

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SECTION 7.

BALLOON DEFENCES ACCEPTED.

The Sub-Committee on Air Defence Research.

S.22930/11. Encl. 8A.

Early in 1936, at the 8th meeting of the Sub-Committee on Air Defence Research, it was decided that:-

(a) The Air Ministry should consider the number of balloons required for low altitude barrages.

(b) The Air Staff and General Staff should investigate and report upon the provision and training of personnel for the operation of balloon barrages.

(c) On the assumption that the balloon is an effective means of defence, the Air Staff and General Staff should consider and report on the best location or locations for balloon barrages, having regard to the tactics of attacking and defending aircraft.

The Air Staff View.

Ibid.

The Air Staff considered that in view of the limited experience available in the operational handling of balloon barrages, and of the possibility that the experiments that were in progress at this time[1] might materially affect balloon and cable design, protection by balloons should begin by the implementing, in stages, of a scheme for a continuous low barrage covering the central portions of London and the dock area. This scheme comprised

/a

1. See pp.

a circle of approximately seven miles radius from Charing Cross with an extension along the Thames eastwards to the vicinity of Erith. The aim was to form a continuous barrage, but the exigencies of open spaces suitable for siting would necessitate an irregular perimeter and the staggering of various sections of the barrage. The effect of such a barrage, it was suggested, would be to induce enemy aircraft to approach the protected area at a height suitable for their engagement by gunfire and by fighter aircraft.

Requirements for the London Barrage.

It was estimated that approximately 450 balloons of 20,000 cubic feet capacity would be required for the completed London scheme. These would provide an average spacing of nine balloons a mile[1], a density giving a 1 in 10 chance of contact with an aircraft of 60 feet span for each passage through the barrage. It would probably be unnecessary, particularly at the outset of hostilities, to close the barrage at the western side of London; but if the enemy intelligence were efficient, raiding aircraft might tend to utilise westerly lines of approach for low flying attack, and it was considered desirable, therefore, that this quarter should be fully reconnoitred so that the barrage could be completed at short notice.

The Air Staff recommended that the question of providing balloon barrages for other vital targets should be deferred until more

/handling

1, No difficulty was anticipated in spacing 20,000 cubic feet balloons 9 per mile. In favourable circumstances, the Air Staff considered they could probably be operated at 150 yard intervals.

handling experience of the existing 20,000 cubic feet balloon had been obtained and until the experiments on the damage likely to be sustained by the aircraft after impact with the various types of cable had progressed further. Whilst the Air Staff were aware of the desirability of protecting such important targets as Billingham-on-Tees, they felt it would be difficult to make a sound selection of locations for balloon barrages until the industrial reconnaissance, which had been initiated by the Home Defence Committee[1], had proceeded further.

Organisation.

Because of the necessity for close co-operation with fighter aircraft, it was considered that balloon barrages should, in the form of a balloon group, constitute an integral part of the Royal Air Force, placed under the Fighter Command[2] for administration, training and operations. Pending practical experience, efficient operational units could be formed on an auxiliary basis with a total of 10? full-time personnel, either service or civilian, for maintenance and instructional duties. Either the Royal Airship Works at Cardington or the Royal Air Force Balloon Centre at Rollestone Camp could be utilised as a training centre for the full-time nucleus and a detailed investigation was being made into their respective merits.[3]

Small units being uneconomical, it was recommended that the balloon barrage organisation should consist of wings of four or five squadrons,

/each

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1. See pp.
2. Formerly Air Defence of Great Britain.
3. Cardington was ultimately chosen.

each squadron having five flights and each flight having ten balloons. A suitable first step to implement the suggested London barrage would be the provision and training of the 10% full-time personnel. This cadre, subsequently to be embodied into the auxiliary units, would, with the corresponding amount of equipment, suffice for approximately five miles of barrage, being equivalent to one squadron of fifty balloons. In a sudden emergency, this force could be distributed across the most probable lines of enemy approach between the north-east and the south-west of London.

Costs.

The following estimates were suggested as a "cock-shy."

(a) Cost of balloons and hydrogen equipment for 50 miles of low barrage, 9 balloons a mile... £800,000

(b) Corresponding operating and maintenance personnel, excluding supply services... £5,000

(c) The 10% regular nucleus would be 500 men, and the cost of its equipment would be..... £80,000

War Office Informed.

The next move was for the Air Council to inform the War Office of these views and at the same time to state that it was their opinion that the responsibility for the provision and training of personnel for the balloon barrages should rest with the Air Ministry. This was done in April, 1936, the Air Council adding that the technical

S.22930/11. Encl. 14A.

/development

development and supply of balloon equipment was already an Air Ministry responsibility. It was pointed out, also, that of the 5,000 airmen required to man the barrage many might be of an age that would render them unsuitable for other forms of service, in particular, the territorial army. The War Office agreed with these views, but requested that in the event of experience showing that balloon barrages would be necessary for the defence of ports abroad, or for the Field Force, the Air Council should satisfy these requirements.

Ibid. Encl. 17A.

First Equipment Ordered.

Meanwhile, steps had been taken to put into effect the Air Staff's recommendations and, on the 25th May, 1936, the Secretary of State for Air (Viscount Swinton) stated that the first move should be the ordering of the equipment for forty-five balloons. This was a necessary preliminary to the full production of the five hundred balloons which were required for the London barrage scheme.

Ibid. Encl. 17B.

The Sub-Committee on Air Defence Research having approved the low altitude balloon barrage in principle,[1] Lord Swinton had spoken to Sir Warren Fisher (Permanent Secretary to the Treasury) who agreed that firm orders should be placed immediately for all the equipment for the forty-five balloons. Having gained experience from this it would be possible to put forward to the Treasury Inter-Services Committee the plan for the production of the balance of the five hundred. It would also be necessary to put forward to the Treasury a complete scheme for the formation, accommodation and training of the personnel.

/Memorandum

1. At the 9th meeting.

Memorandum by the Secretary of State for Air.

Before anything further could be done, however, it was essential that authority to go ahead should be received from the Committee of Imperial Defence. Thus, on the 16th July, 1936, the following memorandum by the Secretary of State for Air was issued:-

C.I.D. 234A.

"I think I ought to obtain formal covering authority from the Committee of Imperial Defence for the complete balloon barrage for the defence of the London area. This question has already been fully considered by the Air Staff, the Air Defence of Great Britain Committee, and by the Air Defence Research Committee. A complete low altitude balloon barrage is an integral part of the air defence of London. This is a low balloon barrage of an altitude of approximately 5,000 feet, and is independent of the developments which, by pooling experiments with the French Government, we hope will result in a feasible high altitude barrage near the coast.

The number of balloons for the complete London defence is 450. The Treasury have authorised the orders for the first 50 of these balloons. The specification for balloons, winches and lorries is already out, and we are proceeding with the necessary orders. In the light of this experience, the Air Ministry will be able to decide the quickest and most economical way of securing full equipment, and the proposals for this will be submitted to the Treasury Inter-Services Committee in the regular manner. But I understand from the Treasury that they would wish formal approval by the Committee of Imperial Defence for the plan.

Delays which must inevitably occur in the supply of other elements in air defence make it the more necessary that the London balloon barrage should be put in hand and completed as soon as possible. I hope we shall have our plans ready to put before the Inter-Services Committee before the Committee of Imperial Defence meets again after the holidays, and I take this opportunity of asking for the necessary covering authority."

Home Defence Committee's Recommendations.

C.I.D. 237A.

A week later, on the 23rd July, the Home Defence Sub-Committee of the Committee of Imperial

/Defence

Defence, also issued a memorandum on low balloon barrages. Their recommendations were similar to those of the Air Staff, but they added a proviso to the effect that whilst they appreciated that the primary requirement was the provision of a low barrage for the defence of London, they would like a part of the balloon barrage to be regarded, in the same way as part of the guns and searchlights, as a pool. The adoption of such a plan would enable barrages, or a portion of a barrage, to be moved for the defence of other vital areas, should the necessity arise, and would have the advantage of keeping the enemy in doubt where they would encounter a barrage.

Committee of Imperial Defence Approves the Barrage.

Minutes of the 281st meeting of the C.I.D. 30th July, 1936.

These memoranda came up for the consideration of the Committee of Imperial Defence at their 281st meeting held on the 30th July, 1936.

The Committee approved -

> "the provision of the complete barrage proposed, consisting of 450 balloons with the necessary equipment and personnel, the quickest and most economical way of securing this additional equipment being discussed with the Treasury Inter-Services Committee in the ordinary manner."

They also took note of a statement by the Secretary of State for Air, in which he explained the present position with regard to high altitude balloon defence. This was less satisfactory than had at first been thought. Contacts had been established with the French with the object of obtaining their experience in this form of defence, but the Air Ministry had been misled as to the extent of the French preparations and, in fact, at the moment there only existed one such balloon in France. There were also certain difficulties with the

/French

French company which was undertaking the construction of this equipment.

Lord Swinton proposed as a first step to have a talk with the French Military Staff and find out how they were proposing to obtain the equipment from the company in question and, in the light of that discussion, to determine the best methods of approach by the Air Ministry.

In reply to a query from Sir Samuel Hoare, Lord Swinton confirmed that experiments were being carried on in this country and, if things went wrong with the French company, he hoped it would be possible to design and construct the equipment here. In any case it would be much simpler to copy the French design.

Further Progress Note by Chief of Air Staff.

By October the London balloon barrage scheme had advanced sufficiently for the Chief of Air Staff to issue a further note to the Committee of Imperial Defence outlining progress.

C.I.D. 242A.

He stated that there were serious objections to linking the balloon force with the operational Auxiliary Air Force squadrons,[1] and it had been decided that, as a first step, each balloon squadron should have a separate headquarters though some use should be made of the Auxiliary Air Force Stations later on. The accommodation at each

/headquarters

1. The proposal that a start should be made with the balloon barrage by building balloon squadrons on to the existing London A.A.F. squadrons had been put forward by the Air Member for Personnel. The main objection to this was that it was desirable to recruit each particular balloon squadron from the district in which it was destined to serve. With the possible exception of Hendon, however, none of the A.A.F. stations was conveniently situated for this purpose and, in any case, the start was to be made in the east of London, and not in the west.

headquarters would comprise a balloon shed, a store where the balloons and other equipment could be kept, a drill hall and barrack accommodation for about fifty men.

Administration of Balloon Force.

The balloon force would be administered as a separate organisation under a senior officer, but initially the administration might be undertaken by No. 6 (Auxiliary) Group. Each squadron would be commanded by a non-regular squadron leader assisted by a regular adjutant; retired officers might be appointed to some of the adjutant posts later. The flight commanders would be non-regular, as also would be the balloon crews, with the exception of one rigger/winch-driver for each balloon. The size of a balloon crew was still to be determined, but ten was regarded as the maximum.

Preliminary Training.

As a preliminary step to providing the regular personnel, fifty riggers and fifty winch-drivers were being trained at Larkhill and were due to go to Cardington in December. The intention was that they should be trained there for the combined trade of rigger/winch-driver and subsequently undertake at Cardington the training of three hundred aircrafthands for the same duties. A further hundred aircrafthands would also be trained at Larkhill when the present course was finished. This would provide the full complement of five hundred regular rigger/winch-drivers which the scheme required.

Uniforms and Pay.

It was intended that the balloon force should be provided with uniform under the same regulations as applied to the Auxiliary Air Force. The

/personnel

personnel would not wear wings, but would be provided with a separate badge.[1] It was proposed that their pay should be in line with that for territorial personnel serving on anti-aircraft guns and searchlights.

Age Limits.

Subject to agreement with the territorial associations, the age limits for personnel would be:-

Officers:	32 to 50 so as not to interfere with flying personnel.
Airmen:	32 to 50 with a proviso that N.C.Os could be extended to 55.[2]

Equipment - Balloons and Winches.

The following orders had been placed:-

Balloons.

Dunlops.	Contract 50. I.T.P.[3] 250 Deliveries due to commence with 3 in January, 1937, rising to 30 a month in July; complete February, 1938.
R.F.D.Co.	I.T.P. 140. Deliveries promised: 20 by the 31st December, 1936, and 10 a month thereafter.
Cardington.	To complete 20 by the end of December, 1936.

/Cables

1. This matter was not pursued. No badge was ever issued.

2. Owing to the disappointing response to the appeal for recruits the age limit for airmen was lowered, and in February, 1939, the 4th Edition of Air Ministry Pamphlet 64 laid down:-
"Men - Candidates must have attained their 25th birthday but must not normally have passed the age of 50 except that men under the age of 25 may be accepted provided they are not physically fit for ordinary enlistment in the Auxiliary Air Force but otherwise attain the medical standard laid down."

3. "Instructions to Proceed." Given as a preliminary order in cases where a contract had not already been placed but where manufacture was not to be held up on that account.

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Cables. 50 - 7,000 feet cables for the first 50 balloons had been ordered and 11 of these had been delivered. Tenders had been invited for the cables for further balloons and no difficulty was anticipated with regard to delivery.

Winches. A winch had to be considered with power unit, gearbox, etc. mounted on a lorry chassis. An initial order for 47 winches had been placed with Messrs. Scammell and delivery of the first trial winch was expected by the 21st October. If satisfactory, bulk deliveries were promised, 5 by the middle of November, followed by weekly deliveries, completing by the end of December.[1]

These winches were being fitted with Crossley power units, which were also on order. No difficulty was expected in obtaining delivery of the power units. The winches, complete with power units would be mounted on Crossley fire-tender chassis. An order had been placed for 46 chassis, of which 21 had been delivered, and the balance was expected before the end of the year.

About 450 additional winches were required for the complete scheme and tenders had been invited for quantities up to 1,000 on the basis of Crossley power units. Two firms only had submitted quotations which could be considered having regard to design, price and delivery. These were Scammell and Wild.

The price of the Scammell winch was appreciably higher. Delivery was promised at the rate of 15 to 25 winches a week, commencing after 10 weeks from the placing of the contract and according to the size of the order. It was not, however, considered safe to place complete

/reliance

1. The Director of Aeronautical Production, however, expected that only about 10 in all would be delivered by that time.

reliance upon this promise.

Wilds had offered a winch specially designed for mass production, at a lower price, with a delivery of 10 per week after 12 to 13 weeks. This output could be increased at an extra charge.

From the point of view of design, technical opinion favoured the Wild winch.

If their promised delivery satisfied requirements, there seemed to be good reason for placing the whole of the order with them. On the other hand, even if their programme was fully realised, it would run very close to delivery requirements, and the Chief of Air Staff suggested that it might be safer to divide the initial order, giving the major portion to Wild and the remainder to Scammell. Either winch could be probably fitted with the cheaper Ford V8 engine, which was at this time being tested on a Wild winch for comparison with the Crossley engine.

The type of chassis on which the new winches should be fitted was still to be settled. The alternatives were the Crossley chassis, the Ford Sussex chassis, or the Straussler trailer. No difficulties were anticipated in obtaining supplies of any of these to keep pace with the winches, and 100 Ford Sussex chassis could be made available.

Hydrogen.

It was at first intended that the whole of the hydrogen required for the balloon force should be obtained from gas works but, in view of their vulnerability, one-third of the total requirement would be met by mobile silicol plants. A new type of silicol plant had been ordered from France for experimental purposes.

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It was considered that three gas works would suffice, one of which might be the Fuel Research Station, East Greenwich. Special plant would have to be installed at a cost of about £15,000.

It was estimated that 17,000 cylinders would be required for distributing the hydrogen and so far supply action had not gone beyond obtaining tenders for the 1,740 cylinders required for the first 50 balloons. A new type of 600 cubic feet high pressure cylinder was recommended, and the only firm that had quoted for these was Messrs. Chesterfield. Their quotation was regarded as on the high side and amounted to a total of £28,700 as against the Treasury authorisation of £25,000.[1] The delivery offered was 150 a week after 14 weeks. Another firm had quoted for the older type cylinder with a lower pressure and only 400 cubic feet capacity. Chesterfields revised proposals for accelerated delivery were awaited. The Chief of Air Staff considered that it might be possible to interest more firms in this supply in view of the much larger quantity in prospect. He added that an enquiry had been sent to the Air Attaché, Washington, by the Director of Aeronautical Production as to the possibility of obtaining cylinders from America.

Committee of Imperial Defence Authorises Balloon Barrage Scheme.

Minutes of 283rd Meeting of C.I.D.

The subject of balloon defences again came before the Committee of Imperial Defence on 29th October. The Secretary of State for Air informed the Committee that he had circulated a full statement of the Air Ministry proposals to the Committee of Ministers. This would be circulated to the

/Committee

1. For further details concerning the cost of the London balloon barrage see pp.

Committee of Imperial Defence for information[1] and, they in turn, agreed that, subject to the concurrence of the Treasury in the estimates that were now being submitted to them, full authority should be given to the Air Ministry to proceed with the provision of the balloon barrage scheme for London.

Balloons and the Two-pounder Pom-Pom.

Lord Swinton then referred to the question of low flying which had considerable bearing upon the balloon barrage problem. It was being suggested that the two-pounder pom-pom was the weapon which should be employed. The danger of falling shells from these weapons in close defence should not be overlooked and he thought the possibilities of extending balloon barrages as an alternative means of local defence against low flying should be given consideration. Sir Maurice Hankey, in reply, stated that the Home Defence Sub-Committee on the Air Defence of Great Britain was at the moment considering the question of the best gun for use in defence against low flying, and that another Sub-Committee of the Home Defence Committee, which was engaged on a survey of the vital points in the country, was giving consideration to the best means of providing the requisite local defence of vital points. This would include the examination of the need for balloon barrages at places other than London.

Delays in Treasury Approval.

The higher policy having been agreed upon, the Air Ministry set to work to put the scheme

/into

1. Subsequently circulated as C.I.D. paper No. 242A.

into effect as quickly as possible although lack of Treasury approval acted as a brake on progress. On the 24th October, the Air Ministry had given the Treasury a general note on the financial cost.

S.44336. Encl. 1A.

Broadly there was, or so the Air Ministry thought, a clear understanding between the Departments that the Air Ministry should proceed with the various elements of the scheme, coming to the Treasury for the particular services in detail. The Air Ministry, therefore, went ahead with these essential elements, with the concurrence of the Treasury, placing contracts for balloons and other equipment, arranging for the special motor transport that was necessary and training the nucleus of the personnel.

On the 1st March, 1937, an outline of the proposals for the provision of lands and buildings to complete the general picture was put to the Treasury Inter-Services Committee. On account of the ever increasing cost, these were held over for reference to the Chancellor of the Exchequer who, on giving them his consideration, decided that he could not approve of the proposals until a full report on the complete scheme had been submitted to, and reconsidered by, the Defence Policy and Requirements Sub-Committee. Mr. Neville Chamberlain had come to this decision because -

Ibid. Encl. 3A.

> "in the first place I think that the initial cost and maintenance cost of the scheme (approximately £2,400,000) should be brought home to the Air Defence Research Committee so that they may weigh up the expenditure involved with the gain to our defences to be derived from this form of air defence, in the light of most recent investigations. Secondly, I gather that no inconsiderable part of the cost of the scheme in its present form is attributable to the assumption that the barrage must be capable of being mobilised at very short notice."

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Ibid. Encl. 1A.

In coming to this decision, the Chancellor had placed the Air Ministry in a very awkward position. By this time three parts of their scheme had been virtually completed and No. 30 (Balloon Barrage) Group had been formally established. Some 400 airmen were either in, or had completed, their training; 500 balloons had been ordered; 50 had been delivered, and the remainder were coming forward at the rate of 20 or 30 a month. Winches and prime movers were coming in at a rate of 10 or more each week while 10,000 hydrogen cylinders and 450 trailers had been ordered, and the arrangements for the hydrogen supply were being worked out with the gas companies concerned. In Parliament, members had repeatedly asked when the barrage was likely to be completed. Now the whole project was to be suspended and made embarassingly useless for want of authority to proceed with accommodation.

Ibid. Encl. 3A.

Mr. Chamberlain was not insensible to the Air Ministry's predicament and therefore gave authority for a land purchase for the depot at Kidbrooke.

Air Defence Committee Re-considers the Value of Balloon Barrages.

Ibid. Encl. 7A.

On the 25th May, 1937, the Secretary of State for Air (Viscount Swinton) informed the Chancellor that the Air Defence Research Committee, presided over by Sir Henry Tizard, had re-considered the question of the balloon barrage and had come to the conclusion that recent experiments[1] with balloons had increased the intrinsic value and importance of the low altitude barrage and that

/it

1. The introduction of the Double Parachute Link, see pp.

it was in fact a more valuable means of defence than had originally been thought. Moreover, the Committee had also reported that these other experiments had not reduced the value of the low altitude barrage by providing alternative methods of defence at low altitudes. The most valuable of them had been the R.D.F. scheme[1] for locating and tracing the progress of attacking formations of aircraft. These experiments had shown already that the higher the aircraft the easier and more effective the location. Thus, the various methods of defence were proving to be complementary. The detection and location of aircraft was most effective at high altitudes; the anti-aircraft gun was most effective at the medium altitudes; and the balloon barrage was established as being the most effective, and indeed, the only effective defence, at low altitudes. In these circumstances Lord Swinton asked the Chancellor for the necessary financial authority for the completion of the London scheme, adding that the Air Ministry would take care to avoid any unnecessary expenditure in the establishment of the depots and training centres.

Sir John Simon's Views.

Ibid. Encl. 9A. 19/6/37.

But financial authority was not forthcoming as easily as this. By this time Mr. Neville Chamberlain had become Prime Minister and it was his successor, Sir John Simon, who now continued the economy campaign. Sir John, having surveyed the defence programmes from the financial side, viewed the position with "the utmost gravity."

/There

1. Radio Direction Finding - i.e. Radar.

There was some justification for this view, for not only had the estimates of costs for carrying out the various defence programmes risen steadily, but there appeared to be no sign that finality was approaching. Even more serious was the fact that the forecast of the normal maintenance costs of the defence services (when the expansion programmes had been completed with the aid of money borrowed under the Defence Loan Act) seemed likely to be greatly in excess of any figure which had been contemplated. Unless the matter was dealt with promptly, the country would be faced with normal maintenance costs far beyond anything that could be found out of ordinary revenue. There was a danger as the Chancellor stated -

Ibid.
Encl. 9A.

> "that the Ship of State may be permanently submerged by an impossible burden of defence expenditure."

For these reasons Sir John looked with some little anxiety on a scheme which -

> "when it was stated a year ago, was estimated to cost about one million pounds and is now estimated to cost 2½ million pounds."

Furthermore, he was of the opinion that the balloon barrage scheme had by no means reached maturity and that, as new experiments were carried out, it might be found necessary to effect important modifications in order to make it fully effective. He felt, therefore, that it was only right to warn Lord Swinton that if, at a later stage, the Air Ministry asked sanction for additional expenditure, either on the construction of a new balloon barrage at other centres or on improvements in the existing barrage, it might well be that sanction would not be forthcoming.

/In

In these circumstances he suggested that the whole matter should be fully reviewed; that the Air Ministry should consider whether the contracts which had been placed for the material and equipment for the barrage ought not to be modified or suspended until further experiments had been carried out. In any case, the Chancellor re-affirmed his predecessor's view that it was desirable that the scheme should again be brought before the Defence Requirements Committee.

In the meantime, appreciating that the Government was committed to a balloon barrage scheme for London, the Chancellor gave instructions to ensure that there was no delay in giving authority for the necessary depots and training centres. This, at least, gave the Air Ministry the opportunity of commencing the training of the auxiliary staff.

In reply to these views, Lord Swinton pointed out that while he agreed that there was a need for a complete review of future programmes, he had no intention of submitting plans for new balloon barrages in advance of that; nor indeed did he have any immediate proposals in view. A review had been carried out of the equipment position and, though the greater part had been ordered, it was proposed to suspend action on further orders until such time as the personnel was available to utilise it. This resulted in some £300,000 worth of orders being deferred and went a long way to meet the Chancellor's point.

/Section 8.

SECTION 8.

THE FORMATION OF THE LONDON BALLOON BARRAGE.

It is appropriate now to turn to the more practical side of the formation of the London Balloon Barrage.

The first moves in this direction were to form a suitable organisation to administer the barrage; to find suitable sites from which to fly the balloons; to earmark buildings that would serve as flight and squadron headquarters; and to select sites for the four main depots which would be necessary for recruiting, training and equipment storage.

S.22930.
Encl. 34A
30/9/36.

The Chief of Air Staff felt that there was no time to lose and intimated in September, 1936, that he wished to see the whole scheme in being by the end of the following year. Unfortunately, nobody realised the magnitude or complexity of the novel problem with which the Air Staff were faced and the many difficulties that presented themselves effectively prevented the fulfilment of what was, in the circumstances, an impossible task.

Formation of No. 30 (Balloon Barrage) Group.

The choice of two organisations to administer the barrage presented itself; either to place the administration under No. 6 (Auxiliary) Group, which was already seriously overloaded with the work of forming new flying squadrons, or, as the Chief of Air Staff himself preferred, to create an entirely separate organisation. In either case the operational control of the barrage and the training must of necessity be vested in the Air Officer Commanding-in-Chief, Fighter Command, who was responsible for the whole air defence of Great Britain.

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E.P.M.77. 3/4/37.

The decision was reached to create a new organisation, and No. 30 (Balloon Barrage) Group was accordingly formed within Fighter Command on 17th March, 1937.

S.718552. Encl. 13A. 15/3/37.

The group was to take entire administrative charge of the balloon barrage organisation and to command the four balloon depots and ten squadrons of which the barrage was to consist, while its co-ordination at Air Ministry was transferred from the Deputy Chief of Air Staff to the Director of Organisation. A specialist branch (O.4.) was formed under the Deputy Director of Peace Organisation to deal with all organisational aspects.

E.P.M. 70. 15/2/37.

Air Commodore J. G. Hearson, Royal Air Force (retired) had been attached to Air Ministry in February, 1937, to act in an advisory capacity, and to assist in the development of the barrage organisation, and on 1st May, 1937, he was appointed Air Officer Commanding the new group. His immediate task was to look for a home for his group headquarters in the centre of the barrage, and accommodation was found, after some difficulty, at Kelvin House, Cleveland Street, London, W.1.

30Group Form 540. P.1.

Ibid. P.2.

On 8th October, 1937, the Air Officer Commanding with his staff[1] moved into these new quarters.

Survey of Balloon Sites.

The main problem up to this time had been that of finding open sites in the London area from which it would be possible to fly balloons.

/The

30 Group Form 540. P.1.

1. The staff at this time consisted of :-

Group Captain W. C. Hicks,
Senior Air Staff Officer.
Group Captain F. A. Baldwin,
Technical Advisor.
Squadron Leader H. Dawes,
Senior Personnel Staff Officer.
Flying Officer A. Green,
Air Staff Officer.

The matter had already been given a good deal of thought for some months before any formal organisation was considered, and the Chief of Air Staff had been in touch with Colonel J. D. Mackworth, an officer with wide experience of balloons in the First World War, to ask if he would be prepared to assist in the development of a balloon barrage organisation. When, therefore, in June, 1936, the question arose of the appointment of an officer under the Deputy Chief of Air Staff to advise on the many questions that would arise on balloon matters, the Chief of Air Staff was able to recommend Colonel Mackworth. This officer took up his duties in the following month and, appreciating that a very considerable amount of work would have to be done, applied for the assistance of two officers in order that the actual survey might begin as soon as possible. Their duties would cover the investigation of sites, not only for the balloons, but also for the flight, squadron and centre headquarters. As a result, two retired officers, Wing Commander C. E. Maude, Royal Air Force, and Commander J. K. Emsley, Royal Navy, were appointed. But as events transpired Colonel Mackworth went sick in December, 1936 and was never able to return to duty, while Commander Emsley died, leaving Wing Commander Maude to carry on single-handed. By this time much preliminary work had been done, although to some extent it represented wasted effort for, shortly after Air Commodore Hearson's arrival at the Air Ministry, an important departure was made from the hitherto orthodox policy of balloon siting.

E.P.M.36. 21/4/36.

E.P.M.44. 30/6/36.

E.P.M.47. 21/7/36.

S.39216. M.1. 17/9/36.

Ibid. Encl. 8A. 26/10/36.

Ibid. Encl. 23A. 15/9/38

(a) "Perimeter" Siting versus "Field" Siting.

Up to now the only method of siting balloons had been to space them as close together as

30 Group Form 540. Encls.1A & 2.

/reasonably

reasonably possible around the perimeter of the area to be defended rather on the style of the fringe on a lampshade, and the original scheme proposed by the Air Staff for the balloon defence of London was based accordingly; there were to be 450 balloons spaced 600 feet apart on the circumference of a circle with a radius of some seven miles from Charing Cross.

It was discovered, however, that there was a grave danger of entanglement at such close intervals with balloons flown at a height of 4,000/5,000 feet. The idea was then modified by providing a double circumference with the balloons not less than 1,000 feet apart, and the siting for this scheme was carried out between July and November, 1937. But "perimeter" siting was not to survive. At the end of December, 1937, the Royal Aircraft Establishment pointed out that instead of siting the balloons in a complete circle round London it would be better to site the balloons over the whole area. If the balloons were sited in a "ring fence" they might or might not catch an invading raider but once the raiders got past or over the fence there would be no protection for any target inside the circle. On the other hand, the even distribution of the same number of balloons defended the whole area and taking an aircraft with a wing span of 70 feet, gave a mathematical chance of impact of 2 to 1, as against 4 to 1.

The Royal Aircraft Establishment, therefore, produced a field siting plan for the London balloons, consisting of the same number of balloons (450) spaced 3,000 feet apart; approximately the same area was covered as before, only,

/owing

owing to the necessity for protecting the Royal group of Docks in East London, an extension in the shape of a blister was provided in this district, and Tower Bridge was taken as the centre of the circle instead of Charing Cross. The reconnaissance for the actual sites was undertaken by No. 30 Group officers headed by Squadron Leader Luck, Royal Air Force, and No. 30 Group's final recommendations were approved by Fighter Command and Air Ministry in November, 1938.

Formation of the Four London Balloon Centres.

S.39326.
M.69.
29/11/37.

It had originally been intended to form a town headquarters for each of the ten London squadrons, but this was found to be impracticable mainly on the grounds of the cost of supplying ten separate establishments with the required facilities and staffs. A revised scheme was then prepared to develop four main depots which would combine the purposes previously intended for the separate squadron town headquarters with those of the proposed depots (or balloon centres as they subsequently became known). These centres came to be situated in the Counties of London, Essex, Surrey and Middlesex.

Org.Memo.
No.128.
25/11/38.

E.P.M.70.
15/2/37.

The centres had been approved in principle by February, 1937, but the story of their siting and development is one of difficulty, obstruction and delay, and, as it transpired, two years elapsed before all four were completed and working as units.

In the first place, some difficulty was experienced in determining the exact requirements for these centres, since no similar type of

/organisation

organisation existed in the Royal Air Force, and the authorities were faced with the awkward problem of the immediate large scale development of a new branch of the service with little or no data to assist them. It was, however, decided that each centre should provide accommodation for the housing of the balloons, transport and technical equipment of its own squadrons, training facilities for the auxiliary personnel, and domestic accommodation for the regular cadre. Generally speaking, balloons for operational purposes would be stored packed, but provision would be made for a small number to be kept inflated for training and experimental purposes. In addition, space would be required for the flying of these balloons, with sheds for housing them when inflated.

Notes on Formation of the London Balloon Barrage by G/Capt. C.E.Maude.

It was necessary to select sites of considerable area for these purposes, it being calculated that a two-squadron centre would require some 60 acres of open land while a three-squadron centre would require an additional 20 acres. It was also necessary that the centres should be so situated as to be within reasonable distance of the war areas they were to serve, with good road and rail access both to allow for auxiliaries to travel to the centres for peace-time training and to provide for the rapid deployment of the squadrons on mobilisation. Further, it was laid down as a requirement by the Air Staff that these centres should not be within five miles of any existing or proposed aerodromes, because balloons flown for training purposes would act as a hazard to civil and service aircraft. Added to all these requirements, it was necessary that the sites chosen

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should not be too near built-up areas owing to the prohibitive cost of such land. Since existing public open spaces such as parks, etc. could not be interfered with, it was a very real problem to find land that would fulfil all these requirements.

E.P.M.70. 15/2/37.

A site for the south-east (No.1) centre was selected at Kidbrooke and acquisition action was put in hand, while the search for the three remaining centres continued. It was important that they should be established as soon as possible, for without them recruiting action could not be taken to form the squadrons, nor would there be anywhere to station the regular airmen who were undergoing balloon training at Larkhill, Cardington and Henlow.

E.P.M.77. 3/4/37.

By the beginning of April a tentative layout for the north-east (No.4) centre at Chigwell had been agreed upon while provisional sites had been selected for the north-west (No.3) centre at Oxhey Lane, near Stanmore, and the south-west (No.2) centre at Hook, the locations having the operational approval of the Air Staff. The Stanmore site was particularly difficult to find owing to the proximity of aerodromes.[1] A good site, however, was found at Harrow which met all requirements, but the land belonged to Harrow School, and such fierce opposition was encountered from the governing body of the school that the project had to be abandoned.[2]

E.P.M.79. 17/4/37.

As a temporary expedient and owing to an anticipated delay of some six months between the receipt of tenders and the completion of the works

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1. Hendon and Northolt.

2. The site finally selected was considered a rather poor alternative.

services contract at Kidbrooke, it was decided to make available some of the old war-time huts in the West Camp of the Maintenance Unit adjoining the site, and the necessary alterations were put in hand. This accommodation would enable an earlier start to be made with the enlistment of auxiliaries and the formation of the first squadrons.

E.P.M.87. 19/6/37.

The position in June was that the Kidbrooke contract had been placed and Treasury approval obtained for the purchase of the selected sites at Chigwell and Hook. It was months, however, before the land purchases were completed owing to disagreement over terms, but No. 1 Balloon Centre, Kidbrooke, was formed on 4th October, 1937, under the command of Air Commodore J. B. Bowen, Royal Air Force (retired). As to the north-west centre, the site itself had not been finally determined.

30 Group Form 540. P.2.

E.P.M.108. 31/12/37.

By the end of the year, the picture was still unsatisfactory. More delay had occurred at Kidbrooke, where it was not expected that building would be completed before April or May, while no completion date could be hazarded for Hook or Chigwell. At Stanmore, an alternative site was being investigated for No. 3 Centre.

E.P.M.124. 30/4/38.

By April, 1938, matters had improved. Kidbrooke was almost completed, Hook and Chigwell were progressing, and two retired officers, Wing Commander R. F. S. Morton, R.A.F.O. and Air Commodore B. C. H. Drew had been appointed on 5th July, 1938, to command these latter centres. At Stanmore not only had another site been decided upon and purchased, but the works services contract had been placed and work was about to begin.

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E.P.M.135. 31/8/38.

On 4th August, both Hook and Chigwell opened with advance parties. Barrack, messing and office accommodation were ready for occupation, though the technical buildings were not completed. Stanmore was still only in a constructional state, but Kidbrooke was working normally.

E.P.M.143. 31/10/38.

Towards the end of the year, as the chain of centres was nearing completion, work was sufficiently far advanced to determine the opening date of Stanmore, which was fixed at 15th December, and the advance party moved in two days earlier. Wing Commander E. A. Bald, Auxiliary Air Force, was appointed to command on 6th March, 1939.

Form 449.

Recruiting and Manning.

S.22930/11. Encl. 7A. 26/3/36.

With the heightening tempo of preparations for war and the increasing demands on the country's limited man-power, the question of recruiting loomed large on the horizon.

It had been decided in March, 1936, that the most suitable and economical method of manning the balloon barrage would be by the formation of Auxiliary Air Force units to be built up on a foundation of some 10% regulars who would act as instructors and be responsible in peace time for the maintenance of balloons and equipment.

Ibid. Encl. 14A. 21/4/36.

The Air Council informed the War Office of their views on this subject in April, 1936, when it was pointed out that the personnel requirements would be in the neighbourhood of 5,000 -

> "of whom many might be of an age that would render them unsuitable for other forms of service, e.g. the territorial army."

The question of man-power being a factor of much importance, the Air Council was at pains to advise the War Office that this new commitment was not

/expected

expected to be a serious competitor in the recruiting campaign.

As it happened, recruiting of the auxiliaries could not be started before training facilities were available and nothing could be provided in this direction, owing to the specialised nature of requirements, before land was bought and buildings erected. Because of the difficulties and delays that were experienced in this respect it transpired that there was a lapse of some two years before serious recruiting began, though the foundations had been laid in December, 1936 when official letters were sent by the Air Ministry to the Territorial Army and Air Force Associations[1] of Middlesex, Essex, Surrey and Kent enlisting their support and assistance. This correspondence was anticipated by personal letters from the Secretary of State for Air (Lord Swinton) to the presidents of those associations.

S.39326. Encl. 15A. 21/12/36.

Ibid. Encl. 17A. 18/12/36.

The official letters announced the intention to establish a balloon barrage for the defence of London and outlined the proposed composition of the force to man it; the conditions of service of the auxiliaries who would form the bulk of the personnel remained to be settled but they would

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1. These associations were brought into being under "The Territorial and Reserve Forces Act, 1907, as applied by Order in Council of 9th October, 1924, to the Auxiliary Air Force." The purpose of the Act was to provide for the formation of local associations for the raising and administering of territorial and auxiliary units. The powers so conferred were very wide and covered the complete organisation and administration (including maintenance) of such units except when they were called out for training or actual air force service, or when embodied.

A.P.968.Pt.I. (2nd Edn.) Appendix 1.

in the main follow follow the general lines of Auxiliary Air Force service with some adaption on account of the affinity the new units would bear to the units of the territorial army engaged on anti-aircraft defence.

Ibid. Encl. 20A. Et. Seq. 23/12/36.

The associations agreed to co-operate but uneasiness was expressed in more than one quarter on the subject of recruiting in view of the already heavy calls on man-power made by the territorial army in the formation of new units including those required for anti-aircraft defence. They were, however, re-assured that the Air Ministry was working in close touch with the War Office and that age limits and conditions of service were still under consideration.

Ibid. Encl. 42A. 15/3/37.

By March, 1937, the details of conditions of service had been worked out and were awaiting Treasury approval after which a pamphlet would be printed for circulation, and the appointment of non-regular officers and the enlistment of auxiliary airmen would be initiated by No. 30 Group Head-quarters in conjunction with the four county associations.

Ibid. M.43. Et. Seq.

The aid of the County of London Association was also enlisted at this time when it had been established that the balloon perimeter would cut through its area in the neighbourhood of Kidbrooke and that the association would probably be required to raise two or three squadrons.

Ibid. Encl. 49A. 19/5/37.

Ibid. Encl. 75A. 16/12/37.

By December the long awaited pamphlet[1] giving information to prospective candidates of qualifications and age and conditions of service was ready for

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1. See Appendix

print and was being held pending the confirmation of the associations that they would undertake to raise and administer the required squadrons. Previously they had only been approached in a general way but they were now asked specifically to commit themselves to a formidable task. Three of the associations agreed at once but Essex was more cautious and it was not until further information was available that it came into line the following month.

Ibid. Encl. 91A. 21/1/38.

Ibid. Encl. 94A. 12/2/38.

On the subject of pay and conditions of service of the non-regular members of the Auxiliary Air Force a letter was written by the Air Ministry in February, 1938 to the Treasury setting out certain proposals which were approved and authorised in the Treasury's reply. These provided for a maximum annual grant to the associations of £1,000 a squadron[1] and the usual connected grants for the medical examination of recruits, general purposes, officers out-of-pocket expenses, personal clothing and accoutrements, and buildings.[2]

Ibid. Encl. 96A. 9/3/38.

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1. As against £500 for an auxiliary flying squadron which had a smaller personnel establishment.

2. The grants were thoroughly discussed in detail inter-departmentally and finally in May a letter was written to each of the associations setting out the position:-

Ibid. M. 97. Et. Seq. 11/3/38.

Ibid. Encl.109A. 13/5/38.

(a) Establishment grant (see A.P.968, para.537) of £700 p.a. for the first squadron, £600 for each additional squadron. (this left the Air Council with £300/£400 per squadron up their sleeve).

(b) General purposes grant (see A.P.968, para.540) of 4/-d. p.a. per head of the authorised establishment of auxiliary airmen.

(c) Officers out-of-pocket expenses grant (see A.P. 968, para.541) at the rate of £20 p.a. for each squadron.

(d) Medical examination of recruits grant at the rate of 2/-d. for each accepted recruit.

(e) Personal clothing and accoutrements grant under consideration and a further communication will follow on this point as soon as possible.

(f) Rent, etc. of buildings grant did not apply, as the associations would not for the time being have any responsibility in this direction.

(g) Travelling expenses of airmen generally and officers attending week-end camps would be paid by the service and the responsibility of associations would be limited to reimbursing officers their out-of-pocket expenses out of the special grant in this connection. (CONT.AT FOOT OF pp.116)

(a) The Opening of the Recruiting Campaign.

DESTROYED
754725/38.
Encl. 1A.
15/3/38.

In March, 1938, Air Commodore Hearson, the Air Officer Commanding, No. 30 Group, began to press strongly for the opening of the recruiting campaign even though Kidbrooke was the only centre that was approaching completion, and therefore the only one of the four that could begin to cope with a full programme. His suggestion was to go ahead at once with the formation of :-

Nos. 901, 902 and 903	Squadrons	at Kidbrooke.
No. 904	Squadron	at Hook.
No. 907	Squadron	at Stanmore.
No. 908	Squadron	at Chigwell.

Ibid.
Encl. 1B.
16/3/38.

Cold water was poured on this suggestion by the Director of Organisation (Air Vice-Marshal C. F. A. Portal), who said that there was no question of accelerating the programme ahead of the completion of the buildings.

Ibid.
Encl. 1C.
18/3/38.

Air Commodore Hearson thereupon pointed out that the existing state of international politics was having a stimulating effect on general recruiting and that there was

> "an overwhelming rush of good keen men anxious to put themselves in a position to help in the case of war, as well of timorous individuals seeking shelter from possible conscription."

If recruiting for the balloon barrage were postponed it would mean losing many good men who would be attracted to other spheres of service, including civil defence, which were calling for prodigious numbers of recruits. On these grounds he urged that recruiting should start immediately even if

/the

S.39326.
Encl.112A.
10/7/39.

It was not until a year later that a decision was reached on paragraph (c) above, when the associations were circulated to the effect that it had been decided to ask them to accept responsibility for the peace time administration of clothing and accoutrements of members of balloon squadrons under the same procedure as held for flying squadrons.

the squadrons were only formed on paper, and that only men clearly suitable in every way should be enrolled.

Ibid. Encl. 6A. 8/4/38.

Air Commodore Hearson's importunity was the balloon barrage's opportunity, for the sought-for permission was granted and as a result of the earlier start of recruiting many good men who would otherwise have been lost to it were attracted into this branch of the service.

(b) Formation of Squadrons.

Ibid. Encl. 9C. Et.Seq. 13/4/38.

With the decision to begin a measure of recruiting in advance of the completion of the centres, letters were dispatched to the territorial associations concerned acquainting them of the position and pointing out that the aim was to attract a steady flow of suitable candidates over a period of some months rather than a torrential rush in a short time. With this end in view it was decided that the following action should be taken with effect from 16th May, 1938[1]:-

No. 901 Squadron) 902 Squadron) ... 903 Squadron)	To form at No. 1 Balloon Centre, Kidbrooke and be raised and administered by the County of London T.A. and A.F.A.
No. 904 Squadron ...	To form for recruiting purposes only at Hook pending the formation of No. 2 Balloon Centre to be raised and administered by the Surrey T.A. and A.F.A.

/No.907

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30 Group Form 540. P.2.

1. The following Auxiliary Air Force officers were appointed to command these squadrons with effect from the same date:-

No. 901 Squadron - Squadron Leader J.S.Wheelwright.

No. 902 Squadron - Squadron Leader J.J.O'Hea.

No. 903 Squadron - Squadron Leader G.M.Haslam.

No. 904 Squadron - Squadron Leader E.J.Davies.

No. 907 Squadron ... To form for recruiting purposes only at Stanmore pending the formation of No. 3 Balloon Centre to be raised and administered by the Middlesex T.A. and A.F.A.

No. 909 Squadron ... To form for recruiting purposes only at Chigwell pending the formation of No. 4 Balloon Centre to be raised and administered by the Essex T.A. and A.F.A.[1].

DESTROYED
S.754725/38.
Encl. 21A.
7/6/38.

It was intended that Nos. 904, 907 and 909 Squadrons should recruit simultaneously for themselves and for their sister squadrons to be formed at later dates, but it became almost immediately apparent that this scheme would not work satisfactorily as there was an inevitable tendency to relegate the less promising material to posterity. For this reason Air Commodore Hearson asked at the beginning of June for authority to raise the remaining squadrons, and these were accordingly formed on parallel lines with effect from 5th July,[2] i.e. -

Ibid.
Encl. 24A.
27/6/38.

No. 905 Squadron .... Hook.
No. 906 Squadron .... Stanmore.
No. 908 Squadron .... Chigwell.
No. 910 Squadron .... Chigwell.

Equipment.

(a) Supply of Balloons for the London Barrage.

The provision of the balloons necessary for

/the

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30 Group Form 540. P.2.

1. The following Auxiliary Air Force officers were appointed to command these squadrons with effect from the same date:-

No. 907 Squadron - Squadron Leader G. Aste.
No. 909 Squadron - Squadron Leader D.J.A.Buxton.

30 Group Form 540. P.3.

2. The following Auxiliary Air Force officers were appointed to command these squadrons with effect from the same date:-

No. 905 Squadron - Squadron Leader W.G.Horne.
No. 906 Squadron - Squadron Leader E.L.Gower.
No. 908 Squadron - Squadron Leader P.L.Dyson-Skinner.
No. 910 Squadron - Squadron Leader A.M.Lyons.

the London barrage and, later, for the provincial barrages, entailed the creation of what was practically a new industry. Only one English firm, Messrs. Spencers, manufactured balloons in 1936, and their products were intended only for commercial purposes. Messrs. Mandleburghs had manufactured experimental balloons for the Air Ministry in the past, but these had not been produced in any numbers.

E.P.M.32. 17/3/36. The Air Council's first intention was to allow The Dunlop Rubber Company to undertake the whole production of balloons and their accessories, and

E.P.M.46. 14/7/36. the firm was invited to submit its proposals for manufacture. These proved to be quite inadequate, and Mandleburghs and another concern, the R.F.D. Company, were then invited to state how many balloons they could produce in nine months without expanding their existing plant, although the Secretary of State for Air was willing to support the idea of a shadow factory for balloon manufacture if necessary.

E.P.M.48. 28/7/36. Revised proposals from Dunlops in July, 1936 anticipated an output of 200 balloons a year. The R.F.D. Company stated its ability to produce 20 balloons by Christmas but, if more were required, new premises would be needed. 20 balloons could also be manufactured at Cardington. Meanwhile, Mandleburghs had dropped out of the picture.

The output of 200 balloons by Dunlops was not considered sufficient, and instructions were given for an estimate to be submitted for providing 300 in fifteen months. It was also decided to plan an order for 20 balloons with the R.F.D. Company and to give them assistance in the erection of buildings in anticipation of further orders.

/In

In addition, balloons were to be manufactured at Cardington in order to help with training and to enable experience to be gained in the industry.

E.P.M.49. 5/8/36. Progress Report 54. 5/10/36.

Following the sanction by the Committee of Imperial Defence for the London barrage, orders were placed with Dunlops, the R.F.D. Company and Cardington for the manufacture of 440 balloons entailing an estimated expenditure of £450,000. Dunlops were to complete their contract for 300 balloons by February, 1938, the R.F.D. Company to manufacture 140, 20 by 31st December and 10 a month afterwards, and Cardington to complete 20 by 31st December, 1936. The balloons produced at Cardington were to be over and above the initial requirement of 450.

Progress Report 81. 1/5/37.

The order to Cardington was soon increased to 60, so that the total of balloons under construction was 500, allowing for a reserve of 50 over the initial requirement.

Although the output of the firms concerned was not always equal to their anticipations, the delivery of balloons continued at an increasing rate throughout the year 1937 until at its conclusion Dunlops had completed 187, the R.F.D. Company 101, Cardington 50, making a total of 338 out of the original 500 approved. This figure was now increased to 550 in order to raise the reserve to 100. The total of 338 available had, however, decreased by 10 as a result of casualties by fire at Cardington in September. In addition, a small number of balloons of 5,000 cubic feet capacity, intended as an economical means of training, had been manufactured, but the production of these was discontinued, as they were found to have no advantages over the standard type. As the initial

Progress Report 70. 15/2/37. Progress Report 23. 30/4/38.

/orders

orders for the London barrage were nearing completion, the question of the future of the balloon industry began to arise, as manufacturing plants would have to be maintained in order to provide for the replacement of balloons destroyed by weather or enemy action. But, as in the early months of 1938, the provision of balloons for the provincial barrages was under discussion, much greater demands were soon made on the newly-created industry to provide for these undertakings.[1]

(b) Supply of Winches for the London Barrage.

Progress Report 54. 5/10/36.

The first orders for balloon winches mounted on lorries for the London barrage were placed with Scammells. This firm had previously supplied winches in small numbers to the Air Ministry for experimental purposes, and the orders for the barrage were intended to create a provisional source of supply until something better could be found. When the decision to make all winches mobile replaced the first project of only allowing 10% or 50% mobility, tenders were invited for 450 winches mounted on power units. Quotations were received from Scammells and Wilds. The Scammell winches, mounted on a Crossley chassis and driven by a Crossley engine, were more expensive than those driven by a Ford V8 engine and mounted on a Ford Sussex chassis, which Wilds were prepared to supply. Orders were placed with Wilds for 405 mobile winches, the remaining 45 to be supplied by Scammells. It was suggested that a number of suitable vehicles originally intended for a Middle

S.37890. M.19.

Progress Report 58. 2/11/36.

/East

1. For information regarding the production of balloons for the provincial barrages, see pp.

East emergency could be used as winch prime movers, but the idea was abandoned as these vehicles would have to be replaced and their use would constitute no real economy.

Progress Report 77. 3/4/37.

S.38651. Encl. 54A. 8/4/37.

Delivery of winches from these firms commenced in 1937. In April, Air Commodore Hearson expressed his dissatisfaction with the position when he pointed out that duplication of types of winch was inadvisable, and also that, in his opinion, the Scammell winches had certain mechanical defects. The fitting of a bollard to a Scammell winch, which Air Commodore Hearson thought would result in mechanising labour and economising in personnel, would be a difficult modification and would cost about £100 for each winch. In addition, the winch was a very heavy vehicle, and the whole unit cost £1,800 as compared with £870, which was the cost of a complete Wild winch. Accordingly, he suggested that the Scammell order should be cancelled, compensation paid if necessary, and Wild winches ordered instead. This suggestion was not accepted as one-third of the complete order with Scammells had been delivered, and three-quarters of the component parts completed.

105 P.M. Progress Report 18. 27/11/37.

118 P.M. Progress Report 21. 28/2/38.

139 P.M. Progress Report 30/9/38.

Deliveries of both types of winch therefore continued, and the order with Wilds was completed by the end of November, 1937, and that with Scammells by the middle of February, 1938, though part of the order for chassis units remained outstanding. Subsequently, the Scammell winches were found to be unsuitable and additional Wild winches were purchased to complete the requirements of the London barrage.

/(c) Supply

(c) Supply of Hydrogen for the London Barrage.

E.P.M.54. 6/10/36.

It was the original intention to obtain all the hydrogen necessary for the London barrage from gas works in the London area. Although hydrogen could be obtained cheaply by this means it was eventually decided not to rely solely upon it, as gas works were considered vulnerable to enemy action. The alternative means of supply was the use of mobile silicol plants, and a specimen Joubert silicol plant was ordered from France in order that tests might be made to determine its suitability for operational use. Static silicol installations existed at Cardington and Pulham, but they were in a state of disrepair. It was decided in September, 1936, to supply one-third of the hydrogen needed from mobile silicol plants if a suitable design could be devised, and the remaining two-thirds from gas works, in which special plants for compression and storage would be installed. The particulars of the expenditure involved were as follows:-

Progress Report 54. 5/10/36.

E.P.M. M.184. 3/12/37.

(a)	Installation of hydrogen plant at the premises of three selected gas companies	£18,000
(b)	Purchase of ten mobile silicol plants.	£50,000
(c)	Purchase of reserve of 1,000 tons of ferro-silicon for use in the silicol plants.... ...	£25,000
(d)	Purchase of 17,000 hydrogen cylinders	£290,000
(e)	Purchase of cradles for transporting cylinders..	£2,500
(f)	Repairs to gas plant at Cardington...	£5,000
		£390,500

These figures were approved by the Treasury with the exception of those relating to the purchase of

/reserve

SECRET

reserve ferro-silicon which was referred to the Sub-Committee on Accumulation of Raw Materials.

Progress Report 77. 3/4/37.

It was proposed to instal hydrogen plants at the premises of gas companies at Hornsey and Epsom and also to use the Fuel Research Station at East Greenwich for the same purpose. The idea of using Greenwich was soon abandoned as it was pointed out that research work would be hampered and in any case the whole output of hydrogen could not be reserved for the barrage. Installations at either Sydenham or Bromley were suggested instead.

These plans were never fully implemented as the contracts for the installations were not placed owing to the restraint imposed by the Chancellor of the Exchequer on balloon barrage expenditure at that time, while the French silicol plant did not arrive in England until June, 1937 after many unexplained delays.

As training and deployment were impossible without hydrogen supplies, the whole matter was reviewed again and attempts were made to find alternative sources of supply. It was found that there were ample supplies of hydrogen at the works of the Imperial Chemical Industries at Runcorn and Billingham. As this hydrogen was not required for any industrial purpose and was, in fact, going to waste, it would constitute a cheap and plentiful source of supply. If this project could be accepted, the question resolved itself into one of transport rather than supply. Meanwhile, the French silicol plant had been tested with unfavourable results and it was considered that the scheme of using these plants would give neither the mobility nor efficiency anticipated. It had also

Progress Meeting 92. Progress Report 13. 20/8/37.

/come

come to light that the cost of installing hydrogen plants at the works of three selected gas companies was likely to be £110,000 instead of £18,000 as originally envisaged. Thus, it was recommended that the first scheme of supply should be abandoned and all hydrogen obtained from Imperial Chemical Industries, the works at Runcorn acting as the primary source of supply, and the works at Billingham constituting a reserve. By this means it would not be necessary to use mobile silicol plants at all.

Progress Meeting 104. Provision of Hydrogen for Balloon Barrage. 3/12/37.

Proposals founded on these recommendations were submitted to the Air Council in December, 1937. They included financial provisions for the installation of storage and compression plants at Runcorn at the cost of £37,500, and for the erection of similar facilities at Billingham at the cost of £10,000. Hydrogen was to be transported by service vehicles, and for this purpose 47 prime movers were required and 50 trailers to act as an operational reserve. The hydrogen plant at Cardington was to be repaired in accordance with the previous plans and to form another source of reserve supply. These proposals received Air Council and Treasury approval, subject to further consideration of the transport question, and negotiations with Imperial Chemical Industries commenced.

Progress Meeting 108. Progress Report 19. 31/12/37.

(d) Supply of Cylinders for the London Barrage.

The production of a successful type of hydrogen cylinder proved to be a long and difficult business. It was estimated by Colonel Mackworth in September, 1936 that 17,000 cylinders would be required to convey the hydrogen from gas

S.38651. Encl. 34A.

/works

works to the London barrage. This estimate was based on the assumption that there would not be time to re-charge bottles during the initial inflation on deployment. Lord Weir, who attended the Air Council Expansion Progress Meetings in an advisory capacity, agreed with the estimate, but forecast that there would be difficulties over supply. This comment was amply borne out by subsequent events. Tenders were obtained for the 1,740 cylinders required for the inflation of the first 50 balloons.

E.P.M.54. Progress Report 5/10/36.

A new type of cylinder, of a capacity of 600 cubic feet, had been recommended. The only firm offering a quotation for this cylinder was Messrs. Chesterfields and their figure was appreciably higher than the Treasury authorisation. The firm offered a delivery of 150 per week after 14 weeks. It was felt that other sources of supply should be found, and it was even suggested that application should be made to American industry. The difficulties in placing orders were ascribed to the fact that only a few firms could undertake such work, suitable steel was hard to obtain, and the process of manufacture was difficult.

E.P.M.70. Progress Report 15/2/37.

Early deliveries of cylinders were found to develop cracks or flaws, and one cylinder burst under test. As a result of this mishap, which was ascribed to faulty material in the cylinder, an investigation was ordered and a recommendation made that cylinders should be strengthened. The report that all cylinders ordered would have to be scrapped was regarded with dismay, as an insufficiency of hydrogen for balloon inflation purposes would have a serious effect on auxiliary recruiting for the London

E.P.M.108. 18/1/38.

E.P.M.118. 23/3/38.

E.P.M.119. 29/3/38.

/barrage

barrage. The Air Member for Supply and Organisation (Air Vice-Marshal W. L. Welsh) at an Expansion Progress Meeting on 29th March, 1938, was instructed to examine urgently the possibility of using cylinders from old stocks for training at Kidbrooke. At the subsequent meeting, the Secretary of State for Air (Lord Swinton) stated that Chesterfields had admitted responsibility for faulty heat treatment of the metal of the original cylinders, but he believed that this would be rectified by a new process. The 3,000 original cylinders would undergo examination and test for use at lower pressure, and they could be utilised for training purposes.

Progress Report 23. 30/4/38.

E.P.M.133. 26/7/38.

Deliveries of cylinders proceeded very slowly owing to these difficulties, and the Secretary of State for Air was impelled to ask if contracts could be placed with other firms to increase supplies. The storage of hydrogen in tanks to obviate the use of cylinders was also suggested but discarded on account of lack of mobility. By 31st July, 1938, 3,800 new cylinders, made to the new specification, at a pressure of 3,000 lbs. had been delivered, and 2,000 of the original cylinders passed for use at the reduced pressure of 1,800 lbs.

Progress Report 31/7/38.

E.P.M.139. 18/10/38.

In consequence of a cylinder bursting at Cardington at the beginning of October, all cylinders were once more under suspicion, for it was conjectured that hydrogen re-acted on the steel used in the manufacture to the detriment of its strength. It became necessary, therefore, to review again the whole question of the supply of hydrogen cylinders. In the meantime, all cylinders in use were to be reduced from a pressure of 3,000 lbs. per square inch to a pressure of

/2,200

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2,200 lbs. per square inch, and 45 - 50 of these cylinders were now needed to inflate a balloon instead of the 35 - 36 formerly required. It was apparent that a satisfactory type of cylinder must be produced without delay, as the limiting factor in the equipment of new barrages was the difficulty over the supply of cylinders, and no final decision over motor transport requirements for the barrage could be made until the cylinder question was solved.

E.P.M.143. 15/11/38.

A lengthy discussion on various aspects of this problem took place at the 143rd Expansion Progress Meeting on 15th November, 1938, and the Secretary of State for Air was so impressed by its urgency that he said that the best type available should be ordered at once and, if necessary, the patterns changed later. Objection to a heavier cylinder was that it would be difficult for airmen to handle, but it was pointed out that, according to the conditions then envisaged, very little man-handling would be necessary. A heavier cylinder of the same size to fit existing trailers was regarded as a safer proposition than using the existing cylinder at reduced pressure. It was decided that orders should be placed for a heavier cylinder, of the same size as those originally ordered. Accordingly, a new and stronger type of gas cylinder, with increased external diameter and thickness, was approved for use in place of the type that had failed. It was anticipated that 30 of these cylinders, at 3,000 lbs. per square inch pressure, would suffice to inflate a balloon, and delivery was expected at the rate of 500 a week, increasing to 1,000 after 12 weeks.

Progress Report 30. 30/11/38.

/In

In order to enhance the durability of the cylinders, it was proposed to subject them to a process of sand-blasting and metallisation instead of painting, which would be unaffected by man-handling. Metallisation was expected to last for five years or longer. This process would be undertaken by Metallisation, Ltd., Dudley, who would be able to treat the whole output of cylinders from Chesterfields if additional plant was erected for this purpose at their premises, at the cost of the Air Ministry. Authority was accordingly sought from the Treasury Inter-Services Committee for expenditure on the metallisation of cylinders and the erection of suitable plant. Further sanction for the purchase of an additional 5,590 new type cylinders was requested for use in No. 30 Group, and it was proposed to allocate 9,900 of the old type to trailers designed as a mobile operational reserve, or for "topping-up" purposes. Of the 7,700 remaining out of the 17,600 of the initial order, it was considered that about 3,000 would be entirely unusable, and the rest could be used for training purposes and for emergency reserve. This expenditure on additional cylinders was approved by the Treasury.

S.38651.
Encl. 90A.
A.M.Memo.
467.
25/4/39.

(e) Communications.

The first proposals for the establishment of a system of communication between No. 30 Group headquarters, the four balloon centres, Fighter Command and Air Ministry, were by means of the London telephone system, with teleprinters installed at group headquarters and centres. In

S.40311.
Encl. 8B.

/war

war time "switched" lines[1] would be used from group headquarters to each of the ten proposed squadron headquarters. Flights were to communicate with squadron headquarters by arrangement with local subscribers, the Air Ministry paying a proportion of the rental, and the instrument being provided with a special plug. Communication between sites and flight headquarters was to be by despatch rider or or bicycle, which subsequently proved to be a slow and cumbersome method. The Director of Signals agreed with these suggestions, leaving in abeyance the provision of telephone lines to squadron headquarters and flight headquarters until their locations were finally determined.

Ibid. Encl. 8A.

As a result of a discussion between the Chief Signals Officer, Fighter Command, and Mr. T. S. Allen of the Directorate of Signals, in November, 1937, proposals were made as to the number of telephone lines required, with estimate of their cost, together with the additional requirements in case of war. It was later considered that while telephone communication would be satisfactory between groups, centres and squadrons, wireless telegraphy could be used for communications between squadron headquarters and sites. The idea of communication by wireless telegraphywas pursued and enquiries were made for the most suitable equipment for the purpose, while a balloon wireless auxiliary unit was proposed to supplement land lines, or provide for mobile balloon detachments.

Ibid. Encl. 9A.

Ibid. Encl. 20C.

Ibid. Encl. 36A.

During the deployment of the London barrage in September, 1938, squadron headquarters communicated with group headquarters by "switched"

S.47109. Encl. 1A.

/telephone

1. "Switched" lines are those used by the public in peace, but switched over for the use of the Royal Air Force in time of war.

telephone lines as previously arranged, and flight headquarters used the lines of private subscribers. These methods of communication were considered sufficient for mobilisation under peace conditions, but it was doubtful whether they would suffice in war time, and the Air Officer Commanding, No. 30 Group, asked for an establishment of five motor cyclists at each squadron headquarters to act as despatch riders in the event of the breakdown of the telephone system.

Ibid. Encl. 1A (c)

In March, 1939, an Air Ministry memorandum was submitted to the Treasury Inter-Services Committee laying down the requirements for a complete system of telephone communication from groups down to balloon sites, at a cost of £13,320. It provided for telephone lines from sites to flight headquarters, flights to squadrons, squadrons to groups and to centres, centres to groups, from the centres to Croydon Airport, and from groups to Fighter Command at Stanmore. These proposals received Treasury approval with the notable exception of those for telephone communication between flight headquarters and sites, except in the case of those subject to emergency operational control. This matter was raised again by the Air Officer Commanding, Balloon Command, with reference to the fifty balloon sites that were to be permanently manned in London, but the General Post Office authorities retorted that such communications could easily be established on existing public lines.

Ibid. Encl. 73A.

Ibid. Encl. 78C.

/Section 9.

SECRET

EMERGENCY DEPLOYMENT OF THE LONDON BALLOON BARRAGE.

S.44930.
Encl. 1A.

As the result of an Air Staff conference on the 24th May, 1938, to discuss defence measures in the event of war, a signal was dispatched to the Air Officer Commanding-in-Chief, Fighter Command, instructing him to prepare plans to make immediate use of the maximum number of balloons available for the defence of London should an emergency arise. Six days later, the Air Officer Commanding-in-Chief forwarded the proposals of the Air Officer Commanding, No. 30 (Balloon Barrage) Group for the plan required. At most, 100 balloons could be deployed and, in order to get them into the air, a number of difficulties, particularly with regard to equipment, would have to be overcome by improvisation. No useful purpose is achieved by enumerating these, but some indication of the state of affairs may be gained by a statement made by Air Commodore Hearson -

Ibid.
Encls.
11A, B & C.

"I consider it should be put on record"

he wrote -

> "that in my opinion, this unready condition of equipment is due in considerable part to continual delays and queries emanating from the finance branches of the Air Ministry in the matter of details."

Fortunately, the international situation did not warrant a deployment of the balloon barrage until the end of September. By this time the position had improved slightly. The barrage could now muster 142 balloons. However, as none of the squadrons was sufficiently up to strength to work as a separate unit, the balloons were divided into

S.47109.
Encl. 1B.

/three

three groups:-

(a) 60 balloons, extending from Plumstead Marshes along the south of the River Thames up to King's Cross were based on No. 1 Balloon Centre, Kidbrooke.

(b) 51 balloons, extending from Dagenham along the north of the River Thames to King's Cross were based on No. 4 Balloon Centre, Chigwell.

(c) 31 balloons, in an area from King's Cross to Clapham Common and Wandsworth Bridge were based on No. 2 Balloon Centre, Hook.

Personnel.

Each of these groups was commanded by an Auxiliary Air Force officer.

The personnel to man the barrage was composed of[1]:-

3 balloon squadron adjutants.
21 Auxiliary Air Force officers, and
300 Auxiliary Air Force airmen, very few of whom were even partly trained.
260 trained Royal Air Force balloon operators.[2]
100 partly trained Royal Air Force airmen.
400 Royal Air Force airmen untrained and drawn from other Royal Air Force units on mobilisation.
500 Royal Artillery apprentices from Woolwich, none of whom was trained.

Deployment.

The balloons were deployed to their war sites by the evening of the 30th September but, owing to shortage of transport, some of the balloons in group (c) were without hydrogen until the following day.

/The

1. Only 16% of the total personnel manning the barrage were trained balloon operators.

2. Although there were 550 fully-trained balloon operators at this time, 100 were employed on M.T. duties in connection with hydrogen supplies from Cardington; 160 were employed at squadron headquarters dealing with recruits, equipment, and forming new crews; 30 were at Cardington as instructors in No. 1 Balloon Training Unit.

SECRET

The hydrogen supply for the barrage had, in fact, been partly extemporised and the balloons could only be maintained by running lorries back to Cardington for replenishment immediately they were emptied by the initial inflation.

Communications.

A squadron war headquarters had been earmarked for each group of balloons and two telephone instruments, one on the G.P.O. system and one on a switched line to Headquarters, No. 30 Group, were installed prior to the deployment. Communications to the flight headquarters - which were established on deployment in any suitable and conveniently situated accommodation - were by the normal G.P.O. system. Communications to sites were by despatch rider or bicycle.

Housing and Feeding of Balloon Crews.

The crews were billeted during the deployment at houses near their sites, but it was realised that when the full barrage was flown, many sites, such as those situated on Plumstead Marshes, would have no suitable accommodation available, and that tents or huts would be required. A cooking centre was established at a convenient position for each ten balloons but, owing to the unsuitability of the equipment[1] and the fact that it was made available only at the last moment, food was scarce during the first twenty-four hours of the deployment, and many men were able to eat only through the generosity of their officers or local inhabitants or at cost to themselves.

/Balloons

1. Each centre was supplied with a marquee, 5 oil cookers, a Soyer stove, and a variety of cooking and other kitchen utensils.

Balloons and International Law.

S.44930.
Encl. 36B.

One interesting point of international law emerged as the result of the deployment. A balloon flight headquarters had been established on a small grass plot inside the Charterhouse Square Gate to St. Bartholomew's Hospital. The governors of the hospital objected, pointing out that this was an infringement of the Geneva Convention. The matter was therefore examined by the Air Council who came to the conclusion that -

> "the legitimacy, or otherwise, of such location is governed by the terms of Article 27 of the Hague Convention, 1907,[1] regulating the laws and customs of war on land, and by Article 7 of the Geneva Convention, 1929,[2] for the amelioration of the condition of the sick and wounded in armies in the field."

The position was that while there was no prohibition in international law to prevent the placing of any form of armament within the precincts of a hospital, the hospital would lose the immunity from bombardment to which it would otherwise be entitled if any form of armament was so placed.

In the circumstances, the Air Council ruled that balloons should not be sited within hospital grounds.

Lack of Preparedness of the London Balloon Barrage.

Ibid.
Encl. 1A.

Air Commodore Hearson reported the results of the deployment to the Air Ministry on 19th October, 1938 and, in doing so, took the opportunity

/to

1. Article 27 of the Hague Convention, 1907, states: "In sieges and bombardments all necessary steps must be taken to spare, as far as possible, buildings dedicated to public worship, historic monuments, hospitals, and places where the sick and wounded are collected, provided they are not used for military purposes."
2. Article 7 of the Geneva Convention, 1929, states: "The protection to which medical formations and establishments are entitled shall cease if they are made use of to commit acts harmful to the enemy."

to comment on the delays which had resulted in the London balloon barrage being less than a quarter ready after nearly 1½ years of effort.

The initial impetus inherent in the launching of the barrage, stated Air Commodore Hearson, had been mainly absorbed in the ordering of some 500 L.Z. balloons and 452 winches. All these had been supplied. But with the exception of these two items, -

> "there had been an almost universal delay in decision, delay in financial sanction, delay in contract action, and often disappointment in the rate of supply."

The main items which Air Commodore Hearson had in mind were hydrogen trailers, cylinders and ground equipment, and it was clear from his report that he had good grounds for complaint. For example, at the time of the deployment, the following essential items of ground equipment were available only in the quantities shown against them:-

10" Canvas Gas Hose	- 47 lengths against a minimum requirement of 142 for 142 balloons.
10-way Fillers	- 80 against a minimum requirement of 142 for 142 balloons.
Ground Sheets	- 604 against a minimum requirement of 852 for 142 balloons.
Cable Cutters	- Nil against a minimum requirement of 142 for 142 balloons.
Carpenters Stoppers	- Nil against a minimum requirement of 142 for 142 balloons.
10" Junction Pieces	- 54 against a minimum requirement of 142 for 142 balloons.
Pressure Gauges	- Nil against a minimum requirement of 142 for 142 balloons.

/The

The personnel position was little better. The delay in the provision of the balloon centres had resulted in recruiting and training being seriously retarded. Recruiting had been commenced in the middle of 1938, but -

> "was necessarily of a half-hearted and limited nature through inadequacy of training facilities and the lack of stimulus given by the flying of balloons."[1]

There was one encouraging feature of the deployment, however. Only a limited number of balloons was flown. Nevertheless, the Air Officer Commanding was satisfied that, although there were, on an average, less than two trained men operating each balloon, and the remainder were untrained, they could have flown their balloons with few accidents had the need arisen.

Results of Deployment.

As a result of the deployment, a number of "inquests" was held by the various Air Ministry branches concerned. In consequence, action was speeded up, especially with regard to equipment. Other matters also came under review such as the co-ordination of balloon sites with guns, searchlights and the civil defence.

S.47109.
M.24.

In addition, it was generally considered by all concerned that further exercises would be invaluable. The Secretary of State for Air did, in fact, raise this question at the 343rd meeting of the Committee of Imperial Defence, when he stated

/that

1. The value of this stimulus as a recruiting agent was indicated by the fact that 1,000 recruits had been enlisted during the ten days since the exercise, as against 700 recruits enlisted during the previous five months.

that the Air Staff wished to carry out a balloon barrage exercise at the same time as the army carried out a proposed skeleton deployment of the defence of Great Britain. This was agreed to, but later the army cancelled their plans and it was decided to carry out a large-scale balloon barrage exercise during the latter part of April, 1939.

Ibid. M.53.

However, when April arrived, the Assistant Chief of Air Staff (Air Vice-Marshal W. S. Douglas) informed the Chief of Air Staff (Air Chief-Marshal Sir Cyril Newall) that a period of eleven days must elapse before the hydrogen used was replaced, subsequent to the deflation of the balloons. The Chief of Air Staff decided it would not be possible to risk this period without balloons and suggested a trial deployment of all balloons to their war stations without inflating them. This was submitted to the Air Officer Commanding of the newly-formed Balloon Command[1] (Air Vice-Marshal O. T. Boyd) who replied that the Air Officer Commanding, No. 30 (Balloon Barrage) Group had discussed the project with his squadron commanders and it was considered that to carry out such an exercise would be psychologically unsound and would tend to lower the high morale of the auxiliary airmen. The exercise was, therefore, abandoned.

/Section 10.

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1. For the formation of Balloon Command see pp. et.seq.

SECTION 10.

THE EXTENSION OF BALLOON BARRAGES TO THE PROVINCES.

C.I.D. 222A.

Early in 1936, the Home Defence Committee of the Committee of Imperial Defence formed a sub-committee, under the chairmanship of Wing Commander E. J. Hodsell, to examine the protection of points of importance against air attack.

C.I.D. 243A.

At the same time, the Committee of Imperial Defence authorised the employment by the sub-committee of two full-time officers, to carry out a detailed reconnaissance of all points of importance and to make recommendations as to the best means of defending them against air attack.

H.D.C. 209.

The vital points selected by the sub-committee as requiring inspection were drawn from the following categories:-

Private factories of national importance.
Commercial oil installations.
Post Office telephone, telegraph and W/T stations.
Public electricity stations.
Gas undertakings.
Docks.
Vital mills and coldstores.

The two inspecting officers selected, Brigadier E. H. Kelly and Air Commodore I. M. Bonham-Carter, commenced their tour of inspection on the 20th July, 1936 and, in their first report, recommended that balloon barrage defences should be provided for Billingham and the North Tees Power Station. This was the first suggestion by responsible officers that balloon barrages would be of use in defending targets other than London, and it was clear that further suggestions of a similar nature would be forthcoming as the tour of inspection continued.

/By

By February, 1937, a further sub-committee of the Home Defence Committee, under the chairmanship of Air Chief Marshal Sir Hugh Dowding, put forward plans for the "Ideal" Air Defence of Great Britain. This committee had not overlooked the value of balloons, and stated that while no numerical estimates of desirable or practicable provision of balloons could usefully be made at this stage -

C.I.D. 225A.

> "we consider that balloon barrages have practical application to small vital areas and to ports."

Meanwhile, they awaited the development of the London barrage and the reports of the sub-committee on the Protection of Points of Importance against air attack before making further recommendations. At the 7th meeting of the latter committee the following conclusion was recorded:-

H.D.C. (A.A.) 43

> "That the Air Ministry should be asked to give an opinion on the risk of low-flying attack, despite the presence of a balloon barrage."

Air Staff Note on the Deterrent Effect of Barrages.

H.D.C. (A.A.) 43.

Accordingly, in October, 1937, the Air Staff put forward their views on this subject.

They considered that the value of a balloon barrage lay in the threat of collision by an aircraft with either the balloon or its mooring cable, so that the area in which it was effective stretched from the ground to the height at which balloons were flown.

The chances of collision with the balloon itself were slight, but the effect would almost certainly be fatal to the aircraft; on the other hand, it was practicable to space balloons economically over a defended area so that if an aircraft flew over it below the height of the balloons, the chances of collision with a cable

/would

would be considerable.

The effects of collision with the type of cable in use were not known with precision but, although it was not expected that it would in every case prove fatal to the aircraft, there was little doubt that it would, in many cases, cause sufficiently serious damage to make pilots unwilling to face the risk.

The effectiveness of the barrage might be still further increased by the use of devices which were under development to ensure that collision with cables would normally be fatal to the aircraft concerned. It was appreciated that aircraft could, to a certain extent, be protected against cables, but, so far as was known, no power had protected their aircraft in this way, and balloon barrages, therefore, could still be considered to constitute a serious menace to low-flying aircraft.

The deterrent effect of the barrage also depended to a very large extent on the degree of visibility existing at any particular time. On a clear day with good visibility and with no clouds below the maximum height at which the balloons could be flown, the balloons could be seen from a considerable distance, and the deterrent effect would be comparatively local, although the Air Staff considered it would be unlikely for the area defended by balloons to be subject to low-flying attack under these conditions.

When there was cloud and poor visibility and at night the effect would be very much greater, since pilots, being unable to see the balloons or their cable and being unwilling to risk collision, would be forced to fly at an altitude higher than

/that

that which they believed to be the maximum height of the balloons and within a considerable radius of any point at which it was known, or suspected, that a balloon barrage was located.

The Employment of Guns and Balloon Barrages for the Protection of Points of Importance Against Low-flying Attack.

C.I.D. 219A. A.D.G.B. 125. (also H.D.C.280)

At the 8th meeting of the sub-committee on the Protection of Points of Importance against air attack, it was recorded:-

> "That the War Office and Air Ministry be requested to prepare a memorandum on the employment of balloon barrages and guns for the protection of specific points against low-flying attack, including the man-power and financial aspects, as a basis for an early report to the Home Defence Committee."

At the 38th meeting of the Home Defence Committee, it was agreed:-

> "That the question of the provision of 2-pdrs. and their co-ordination with low balloon barrages should be referred to the Sub-Committee on the Reorientation of the Air Defence System of Great Britain."

Memorandum by the General Staff and the Air Staff.

Thus, on the 11th July, 1938, the General Staff and the Air Staff forwarded to the Home Defence Committee a joint note on this subject. This note was the most exhaustive survey of the merits of balloon barrages yet produced and is worthy of careful study.

(a) Minimum Height of Balloon Barrages.

Before examining the main subject, the General Staff and Air Staff reviewed briefly the various methods of delivering low-flying attacks which had so far been developed. These may be summarised under three main headings:-

/Low-level

(i) Low-level Bombing.

An aircraft launching a low-level bombing attack may approach the target in level flight, in a shallow dive, or a preliminary steep dive. The aircraft is adjusted to flight before the moment of release, which may occur at any height up to 1,000 feet.

(ii) Low-dive Bombing.

When attacking by the low-dive bombing method, the aircraft may approach in a continuous glide, or dive from an initial height of about 2,000 feet. The moment of bomb release may occur at any height below 1,500 feet while the aircraft is in the dive or glide. The minimum height of release is determined by the type of bomb and fusing employed, and by the height required to pull out of the dive or glide after release. It may be as low as 300 feet.

(iii) High-dive Bombing.

Aircraft adopting the high-dive bombing method of attack may approach by a continuous or interrupted dive, or glide, with or without engine, from heights above 5,000 feet. The final approach to the target will consist of a dive, or glide, from about 5,000 feet, the bombs being released at about 1,500/2,000 feet. As with low-dive bombing, the minimum height of release is determined by the size and fusing of the bombs employed and the height required to pull out after release.

These various methods of attack had one factor in common; the height of bomb release was

/limited

limited to 2,000 feet and below. Thus, if any system of local protection against low-flying attack was to be effective it must preclude bomb release between ground-level and 2,000 feet. This, therefore, defined the minimum operational height of a balloon barrage.

(b) Mobility.

The Air Staff had already set out their views on the psychological effect which the balloons were likely to produce on attacking pilots. But, in order to make full use of this, the exercise of stratagems was necessary. This, it was suggested, could be achieved by moving a part or whole of the barrage from time to time.

If a balloon barrage were used for the protection of a specific point, no great degree of mobility would be possible. The balloons would have to remain in the immediate vicinity of the point to be protected, and the deterrent effect of the barrage would depend primarily upon its lethal effect, and on the high probability that an aircraft attacking the target would come into collision with a cable. The Joint Staffs thought, however, that a certain degree of mobility was desirable to enable balloon positions to be moved from time to time in accordance with the local situation, but it need not be very great.

A few balloons flown in the immediate vicinity of a specific target requiring protection against low-flying attack would have little deterrent effect except perhaps at night, since the attacking aircraft would be able to release their bombs at the objective and turn away before reaching the balloons. Indeed, the balloons

/might

might be more of a help than a hindrance to the attacking aircraft, since they would act as target indicators.

(c) Number of Balloons Required to Protect a Specific Objective.

In order to form an estimate of the minimum number of balloons required to provide all-round protection for a specific objective, the Joint Staffs considered it necessary, in the first place, to analyse the problem of protecting a small vital point, such as an important power station which, for purposes of theoretical consideration, they considered to be reduced to a point. For purposes of comparison with the two-pounder pom-pom, they took the height of attack as 2,000 feet, which was the maximum height at which the two-pounder could engage with efficiency. As a basis for calculation, therefore, it was assumed that all-round protection was required for a point against aircraft releasing their bombs at heights up to 2,000 feet, at level speeds of the order of 300 m.p.h. An aircraft flying level at this height and speed would release its bombs at a plan range of approximately 1,640 yards from the target. The balloon barrage, therefore, had to be interposed between the aircraft and target in such a way as to make release at this distance a hazardous undertaking.

Disposing of the balloons under the "field" siting method, it was calculated that 45 balloons would offer adequate protection under these conditions, giving a 40% probability of collision if the aircraft flew into the barrage.

(d) Attacks on Balloon Barrages.

A resolute enemy determined to make low-flying attacks against an important target

/protected

protected by a balloon barrage might attempt to shoot down the balloons as a preliminary to attacking the target with bombs. An attack of this kind would, however, have to be carried out in daylight, and in clear weather. Moreover, a number of aircraft would be required, and the operation would take some time to complete. The opportunity for intervention by defensive fighters would therefore be considerable, and the principle form of protection from an operation of this nature, would be the general fighter defence of the country coupled with anti-aircraft gunfire.

(e) Co-ordination of Balloons and Anti-Aircraft Guns.

The Joint Staffs emphasized that balloons must be co-ordinated with anti-aircraft guns, since, in certain circumstances, both would be the components of the air defence of vital areas. The effectiveness of the long-range anti-aircraft guns fell off appreciably below 4,000 feet, while the pom-pom was most effective between 500 feet and 2,000 feet. Above 2,000 feet the effectiveness of the pom-pom deteriorated, since the shell was self-destroying at 2,500 feet. The weak layers in anti-aircraft defence[1], therefore, were from ground level to 500 feet, and between 2,000 feet and 4,000 feet. From these considerations it followed that a balloon barrage would be required to cover these vital areas.

(f) Costs.

It was estimated that a unit of 45 L.Z. balloons would require 450 men for its operation, of which a proportion would have to be skilled.

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1. The General Staff and the Air Staff did not consider the A.A. machine-gun in their analysis because it was an unsuitable weapon for co-ordination with the balloon barrage.

The balloons, together with their equipment, works services, and personnel, would cost £240,000 with an annual recurring cost of £30,000. These figures were based on the cost of the London barrage, and the Joint Staffs considered they were probably an over-estimate[1], since the increase in the size of the balloon barrage organisation might well result in a proportionate decrease in the cost.

A comparison of the cost of a balloon barrage with that of the two-pounder gun showed the latter to be the more economical weapon. But the deterrent effect of these guns would be confined to the immediate vicinity of the protected point and would be almost negligible in poor visibility. The Joint Staffs, taking these points into consideration, decided that a balloon barrage would seldom be justified for the defence of a single point or a small area against low-flying attack and it would be preferable to rely on guns, supplemented -

Ibid.

> "by a few balloons which will produce a deterrent effect during darkness or in misty weather."

In clear weather these balloons would be used to reinforce the gun defences in those directions in which geographical, or other conditions, limited anti-aircraft fire.

If an area was to be protected, however, the advantage would shift from the gun to the balloon. Thus, it was evident that the two forms of defence were complementary, and the Joint Staffs recommended that for the protection of large areas

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1. On the contrary the figures were considerably under-estimated. For example, the establishment for the London balloon squadrons (of 45 balloons) allowed for 666 men - exclusive of administrative personnel (see Est/Bar/806A dated 11.6.39. Authority 836459/38).

of vital importance, or important areas which received little protection from the general air defence organisation of the country, a combination of balloons (flying at 4,000 feet) and light anti-aircraft guns offered the best defence at least cost.

(g) Danger of Balloons to the Defending Air Force.

Concluding their joint note, the General Staff and the Air Staff reiterated a warning that had been pronounced some fourteen years previously by Air Chief Marshal Sir Hugh Trenchard; that a balloon barrage was potentially as dangerous to the defending air force as it was to the enemy.[1] They emphasized, therefore, that careful co-ordination between the movements of our aircraft and the disposition of balloon barrages was necessary. In general, it should be possible for aircraft to avoid the barrage by flying above the balloons. Difficulties would arise in the neighbourhood of aerodromes, where aircraft were landing or taking off; in the aircraft fighting zone, when fighter aircraft might be required to operate at night at any altitude; in the neighbourhood of flying training schools, where large numbers of inexperienced pupils would be flying at medium and low altitudes; and in those areas through which returning bombers had to fly at a low altitude to facilitate identification. Special precautions might be necessary in order to reduce the dangers in these areas; in particular, it was recommended that the minimum distance from an aerodrome to the nearest

/balloon

1. The toll of British aircraft taken by the balloon barrages during the War was worse than the two Staffs could have anticipated. A survey of this problem will be found on pp.

balloon barrage should not be less than five miles.

Report by the Sub-Committee on the Re-orientation of the Air Defence System of Great Britain.

H.D.C.282. (also A.D.G.B. 129)

The memorandum by the General Staff and the Air Staff was referred to the sub-committee on the Re-orientation of the Air Defence System of Great Britain[1], which had been formulating recommendations to the Home Defence Committee regarding the allocation of light anti-aircraft guns to vital points. In June, 1938, this sub-committee had been instructed by the Committee of Imperial Defence[2] to base their recommendations -

> "on the assumption that balloon barrages will be provided, not only for London, but for all localities at which their employment is considered by the sub-committee to be desirable."

(a) Reconnaissance of Vital Points.

The list of vital points examined by the sub-committee represented an almost complete survey of the points in this country which were vital in the sense that their destruction would be of major consequence to the war effort. Light anti-aircraft artillery defence had been recommended for all of them. The majority of vital points had been reconnoitred in detail in the first instance by Brigadier Kelly and Air Commodore Bonham-Carter and subsequently by army commands, and specific recommendations had been put forward for the scale

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1. Under the chairmanship of Air Chief Marshal Sir Hugh Dowding.

2. The C.I.D. issued this instruction as the result of a report by the sub-committee on the Protection of Points of Importance against air attack which had completed their survey of the country and had recommended among other things that balloon protection should be provided for a number of vital points.

of defence required in each instance.

Because balloon barrages not only protected vital points but areas as a whole, the sub-committee examined certain areas in which the vital points were situated close together, and where, in consequence, balloon defences appeared desirable. These areas were as follows:-

Portsmouth. The great importance of this area, more particularly to the Royal Navy, induced the sub-committee to consider the employment of balloons. The situation was, however, complicated by the presence of aerodromes. The extent to which it would be possible to organise air operations, while still providing an adequate balloon defence, required further consideration.

Southampton. This area was similarly situated with regard to aerodromes and therefore required further consideration.

Plymouth. An extensive balloon defence was not recommended owing to the proximity of the flying-boat base at Mount Batten. The really vital area was comparatively restricted and would be adequately covered by 39 balloons.

Bristol and Avonmouth. The presence of Filton aerodrome prevented the use of balloons to cover the whole of this area. The sub-committee therefore recommended two small and independent layouts, with the addition of eight light guns at Avonmouth to cover the exposed water front.

Port Talbot - Swansea. No gun or searchlight defence had been provisioned for this area which was some distance from the nearest

/fighter

SECRET

fighter sector. The sub-committee considered that a strong combination of light guns and balloons should be provided.

Liverpool, Humber, Tees, Tyne, Glasgow — These areas all presented substantially the same problem, i.e. a corridor defence. The sub-committee recommended the use of balloons in each case for the protection of the vital dock, ship-building and food-distributing areas.

Birmingham, Coventry, Sheffield, Manchester, Runcorn, Derby — These areas contained a larger number of vital industrial establishments and, as in London, the balloon layouts would protect not only the vital points themselves, but also the workers whose services were indispensable.

In addition to recommending balloon protection for these areas, the sub-committee considered a list of isolated points and small areas, for which it was considered that the light anti-aircraft gun should be the primary defence. The employment of a few balloons was recommended at certain of these places to provide some measure of defence against low-flying attack.

The full recommendations of the sub-committee were for 1,005 balloons[1] and 1,112 light anti-aircraft guns.

/This

1. These were to be disposed of as follows:-

Area.	Balloons recommended.
Portsmouth	53
Southampton	46
Plymouth	39
Avonmouth	24
Bristol	42
Liverpool and Birkenhead. ...	85
Humber	72
Tees	26
Tyne	66
Carried forward.	453

Continued on pp.154

This showed a saving of 321 guns from those previously recommended. The cost was calculated at £5,000,000 for the balloons and £10,000,000 for the guns, with recurring costs of £1,000,000 for the former and £500,000 for the latter.

S.45877.
M.1.

The Committee of Imperial Defence at their 331st meeting on the 27th July, 1938, approved the recommendation of the sub-committee of the Home Defence Committee on the Re-orientation of the Air Defence System of Great Britain for the provision of balloons and light anti-aircraft guns. At the same time, they gave authority to the Secretary of State for Air to proceed with the provision of the balloons recommended, subject to the usual arrangements for obtaining Treasury sanction.

Section 11.

Continued from pp. 153.

Area.	Balloons recommended.
Brought forward.	453
Glasgow...	89
Birmingham	153
Derby	24
Coventry	50
Sheffield	67
Manchester	84
Widnes-Runcorn..	60
Total.	980
Balloons to augment gun defence.	
Wrabness (Harwich)	5
Newport and Cardiff Docks...	10
Swansea and Port Talbot Docks.	10
Total	1,005 *

* This figure was later increased by a few balloons.

SECTION 11.

HIGHER ORGANISATION FOR THE CONTROL AND ADMINISTRATION OF THE BALLOON BARRAGE.

The extension of the balloon barrage to the provinces necessitated a review of the organisation for its control and administration. Up to the present, with the barrage confined to London, control had been exercised by Fighter Command, but the problem with which the Air Ministry was now faced was to control and administer the 18 centres and 47 squadrons into which the balloons were now formed.

It was considered uneconomical for each town squadron to have its own centre and therefore, where it was convenient geographically, one centre maintained squadrons in two or more different towns. In addition, although the squadrons for the London area were organised into five flights of nine balloons each, the provincial squadrons, being less concentrated in operation, were organised in three or four and, in isolated cases, two flights of eight balloons each.

The centres and squadrons were, therefore, organised as follows:-

Centre.	No. of Squadron.	Area Served.
No. 1 Balloon Centre, Kidbrooke.	No. 901 (B) Sqdn. 902 " " 903 " "	London.
No. 2 Balloon Centre, Hook.	904 " " 905 " "	
No. 3 Balloon Centre, Stanmore.	906 " " 907 " "	
No. 4 Balloon Centre, Chigwell.	908 " " 909 " " 910 " "	

/No. 5

Centre.	No. of Squadron.	Area Served.
No. 5 Balloon Centre, Sutton Coldfield, Birmingham, N.	No. 911 (B) Sqdn.	
	912 " "	
	913 " "	Birmingham.
No. 6 Balloon Centre, Aythall, Birmingham, S.	914 " "	
	915 " "	
	916 " "	
	917 " "	
No. 7 Balloon Centre, Derby.	918 " "	Derby.
No. 8 Balloon Centre, Lime Tree Farm, Liverpool.	919 " "	Liverpool.
	920 " "	Birkenhead.
	921 " "	
No. 9 Balloon Centre, Warrington.	922 " "	Widnes,
	923 " "	Runcorn.
No.10 Balloon Centre, Manchester.	924 " "	
	925 " "	Manchester.
	926 " "	
No.11 Balloon Centre, Bristol.	927 " "	Bristol
	928 " "	and
	929 " "	Avonmouth.
No.12 Balloon Centre, Titchfield.	930 " "	Portsmouth
	931 " "	and
	932 " "	
	933 " "	Southampton.
No.13 Balloon Centre, Plymouth.	934 " "	Plymouth.
No.14 Balloon Centre, Cardiff.	935 " "	Cardiff.
No.15 Balloon Centre, Long Benton, Newcastle.	936 " "	Tyne
	937 " "	and
	938 " "	Tees.
No.16 Balloon Centre, Sheffield.	939 " "	
	940 " "	Sheffield.
	941 " "	
No.17 Balloon Centre, Hull.	942 " "	Humber
	943 " "	and
	944 " "	District.
No.18 Balloon Centre, Glasgow.	945 " "	Glasgow
	946 " "	and
	947 " "	District.

Obviously the immediate requirement was an increase in the number of group headquarters, and the Air Member for Supply and Organisation (Air Vice Marshal W. L. Welsh) proposed to the Air Council that three additional groups should be formed.

S.46888. Encl. 1A.

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The question whether or not these groups should follow the existing organisation and, as in the case of No. 30 Group, form part of Fighter Command, was discussed at length at a conference convened by the Air Member for Supply and Organisation, which was held on 21st September, 1938, and attended by the Air Officer Commanding-in-Chief, Fighter Command, Air Chief Marshal Sir Hugh Dowding. Here it was agreed that, whatever the ultimate administrative control might be, the operational control must remain with the Air Officer Commanding-in-Chief, since balloons were part of the general defence system and, like anti-aircraft guns, searchlights and the warning systems, must be welded into a co-ordinated whole.

Administrative and tactical training formed a different problem. Air Chief Marshal Dowding was not satisfied with the existing system of administration, as Fighter Command Headquarters had no technical staff for balloon matters and were, therefore, not sufficiently knowledgeable on the working of balloons. Were the balloon barrage to remain its present size, he would have opposed any separation from his administrative control and, indeed, would have pressed for his control to be tightened. The proposed extension, however, meant that his air officer in charge of administration would have to deal with over four times as many centres as at present; this, with all the other ramifications of administration that were involved, and coupled with the administration of the fighter stations and other units within the command, was more than one staff could handle, and a continuance of the system might result in inefficiency throughout the whole

/of

of Fighter Command.

The Air Member for Supply and Organisation recommended, therefore, that a separate Balloon Command should be set up as early as possible under an air officer commanding - not an air officer commanding-in-chief. The air officer commanding would be entirely responsible to the Air Council for the training and administration of the balloon barrage system, except for operations and war training, for which he would be placed under the Air Officer Commanding-in-Chief, Fighter Command.

It was most important that the Air Officer Commanding-in-Chief should maintain close personal touch with the Balloon Command and, for this reason, the two headquarters must be in close proximity to one another.

The Director of Organisation had drawn up proposals confirming the staffs required at the command and group headquarters. While the manning of them was a problem for the Air Member for Personnel, the Air Member for Supply and Organisation considered that a mixture of regular and auxiliary officers on the group staffs would be acceptable. The command staff, he suggested, should be entirely regular, because it would be administrative and would have only a small air staff for co-ordination purposes.

In any case, the Air Member for Supply and Organisation asserted that the Air Officer Commanding, Balloon Command, should be a regular officer
Ibid. on the active list, and not, as in the case of Air Commodore Hearson, the Air Officer Commanding, No. 30 Group, a re-employed retired officer who had not the incentive for further promotion. This, the

/Air

Air Member for Supply and Organisation emphasized, was not a reflection on Air Commodore Hearson, but a matter of principle.

Ibid. M.5. The Air Council approved the Air Member for Supply and Organisation's proposals and the Balloon Command was formed with effect from 1st November, 1938; Air Vice Marshal O. T. Boyd was appointed Air Officer Commanding.

The three new groups were not formed until 1939, but plans had sufficiently advanced by December, 1938, for the Director of Organisation (Air Vice Marshal C. F. A. Portal) to issue a memorandum showing the proposed organisation of the command. This was as follows:-

S.45877. Encl. 40B.

Command Headquarters. Temporarily situated at Kelvin House, Cleveland Street, London, W.1. pending the finding of suitable headquarters near Headquarters, Fighter Command at Stanmore.

No. 30 (Balloon Barrage) Group, Kelvin House, London, W.1.

Administering:-

No. 1 Balloon Centre, Kidbrooke.
No. 2 Balloon Centre, Hook.
No. 3 Balloon Centre, Stanmore.
No. 4 Balloon Centre, Chigwell.

} and affiliated squadrons.

No. 31 (Balloon Barrage) Group, Birmingham.

(Forms February, 1939)

Administers:-

No. 5 Balloon Centre, Sutton Coldfield. (opens July/August, 1939)
No. 6 Balloon Centre, Wythall. (opens July/August, 1939)
No. 7 Balloon Centre, Derby. (opens July/August, 1939)
No. 8 Balloon Centre, Liverpool. (opens July/August, 1939)

} and affiliated squadrons.

/No. 9

No. 9 Balloon Centre, Warrington. (opens July/August, 1939).
No.10 Balloon Centre, Manchester.
} and affiliated squadrons.

No. 32 (Balloon Barrage) Group, Portsmouth.

(Forms February/March, 1939).

Administers:-

No.11 Balloon Centre, Bristol.
No.12 Balloon Centre, Titchfield.
No.13 Balloon Centre, Plymouth.
No.14 Balloon Centre, Cardiff.
} and affiliated squadrons.

No. 33 (Balloon Barrage) Group, Newcastle.

(Forms February/March, 1939).

Administers:-

No.15 Balloon Centre, Newcastle. (opens July/August, 1939).
No.16 Balloon Centre, Sheffield.
No.17 Balloon Centre, Hull. (opens July/August, 1939).
No.18 Balloon Centre, Glasgow.
} and affiliated squadrons.

Balloon Command Comes Into Being.

Balloon Command Form 540. 5/12/38.

Thus the position at the end of 1938 was that Balloon Command was in communication with the various territorial army and air force associations concerned and had placed upon them the onus of finding temporary town headquarters at which recruiting could be commenced and elementary training given. The programme planned was that these headquarters would open up in mid-January, 1939 and begin recruiting immediately. Instructors and equipment to enable preliminary ground instruction to proceed would be started in the middle or end of February, while early in April, instructors and balloon crews would be borrowed from the London barrage to enable practical balloon training to be carried out. During the

/next

next few months the various units and formations came into being. The squadrons were formed firstly at temporary town headquarters and, pending the formation of the groups, were administered direct by Balloon Command.

By the 1st May, No. 31 (Balloon Barrage) Group,[1] which had formed at Kelvin House, took over the executive command of its centres and moved to its headquarters in Broad Street, Birmingham.

Just over two weeks later, on the 15th May, Nos. 32[2] and 33[3] (Balloon Barrage) Groups moved from Kelvin House to Portsmouth and Newcastle-upon-Tyne respectively to take charge of their centres.

By July, 1939, all centres except No. 16 Balloon Centre, Sheffield, and No. 18 Balloon Centre, Bishopbriggs, Glasgow, had opened, and Balloon Command was no longer a command on paper only.

Thus, on the 3rd July, 1939 a further Organisation Memorandum was issued which read:-

Org.Memo. 364.

Balloon Command.

It is notified for information that the Balloon Command is comprised as follows:-

1. Balloon Command Headquarters.

Temporarily at:-

Kelvin House, Cleveland Street, London, W.1.
Moves to Church Lane, Stanmore, at end of 1939. Date to be fixed later.

/No.30

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1. Commanded by Air Commodore R. F. S. Morton.
2. Commanded by Air Commodore D. H. C. Drew.
3. Commanded by Air Commodore H. R. Busteed.

2 No. 30 (Balloon Barrage) Group.

Kelvin House, Cleveland Street, London, W.1.

(i) No. 1 Balloon Centre, Kidbrooke, S.E.3. 135 balloons.

No.901 (County of London) (Balloon) Squadron.
(5 flights each of 9 balloons) (45)

No.902 (County of London) (Balloon) Squadron.
(5 flights each of 9 balloons) (45)

No.903 (County of London) (Balloon) Squadron.
(5 flights each of 9 balloons) (45)

(ii) No. 2 Balloon Centre, Hook, Surrey. 90 balloons.

No.904 (County of Surrey) (Balloon) Squadron.
(5 flights each of 9 balloons) (45)

No.905 (County of Surrey) (Balloon) Squadron.
(5 flights each of 9 balloons) (45)

(iii) No. 3 Balloon Centre, Stanmore, Middlesex. 90 balloons.

No.906 (County of Middlesex) (Balloon) Squadron.
(5 flights each of 9 balloons) (45)

No.907 (County of Middlesex) (Balloon) Squadron.
(5 flights each of 9 balloons) (45)

(iv) No. 4 Balloon Centre, Chigwell, Essex. 135 balloons.

No.908 (County of Essex) (Balloon) Squadron.
(5 flights each of 9 balloons) (45)

No.909 (County of Essex) (Balloon) Squadron.
(5 flights each of 9 balloons) (45)

No.910 (County of Essex) (Balloon) Squadron.
(5 flights each of 9 balloons) (45)

3 No. 31 (Balloon Barrage) Group.

Headquarters - Birmingham. Temporary address:

176, Broad Street, Birmingham.

(i) No. 5 Balloon Centre, Whitehouse Common, Sutton Coldfield, Birmingham, N. 88 balloons.

No.911 (County of Warwick) (Balloon) Squadron.
(4 flights each of 8 balloons) (32)

No.912 (County of Warwick) (Balloon) Squadron.
(4 flights each of 8 balloons) (32)

No.913 (County of Warwick) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

/No.6

(ii) No. 6 Balloon Centre, Wythall, Birmingham, S. — 112 balloons.

No.914 (County of Warwick) (Balloon) Squadron. (4 flights each of 8 balloons) (32)

No.915 (County of Warwick) (Balloon) Squadron. (4 flights each of 8 balloons) (32)

No.916 (County of Warwick) (Balloon) Squadron. (3 flights each of 8 balloons) (24)

No.917 (County of Warwick) (Balloon) Squadron. (3 flights each of 8 balloons) (24)

(iii) No. 7 Balloon Centre, Curzon Lane, Alvaston, Derby. — 24 balloons.

No.918 (County of Derby) (Balloon) Squadron. (3 flights each of 8 balloons) (24)

(iv) No. 8 Balloon Centre, Fazakerley, Liverpool. — 88 balloons.

No.919 (West Lancashire) (Balloon) Squadron. (4 flights each of 8 balloons) (32)

No.920 (West Lancashire) (Balloon) Squadron. (4 flights each of 8 balloons) (32)

No.921 (West Lancashire) (Balloon) Squadron. (3 flights each of 8 balloons) (24)

(v) No. 9 Balloon Centre, Houghton Green, Warrington. — 64 balloons.

No.922 (West Lancashire) (Balloon) Squadron. (4 flights each of 8 balloons) (32)

No.923 (West Lancashire) (Balloon) Squadron. (4 flights each of 8 balloons) (32)

(vi) No. 10 Balloon Centre, Bowlee, Middleton, Manchester. — 80 balloons.

No.924 (East Lancashire) (Balloon) Squadron. (4 flights each of 8 balloons) (32)

No.925 (East Lancashire) (Balloon) Squadron. (3 flights each of 8 balloons) (24)

No.926 (East Lancashire) (Balloon) Squadron. (3 flights each of 8 balloons) (24)

/No.32

4 No. 32 (Balloon Barrage) Group.

Headquarters - Commercial Chambers,

1/13, Commercial Road, Portsmouth, Hants.

(i) No.11 Balloon Centre, Pucklechurch, Bristol. 72 balloons.

No.927 (County of Gloucester) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

No.928 (County of Gloucester) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

No.929 (County of Gloucester) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

(ii) No.12 Balloon Centre, Southampton Road, Titchfield, Fareham, Hants. 96 balloons.

No.930 (Hampshire) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

No.931 (Hampshire) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

No.932 (Hampshire) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

No.933 (Hampshire) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

(iii) No.13 Balloon Centre, Collaton Cross, Yealampton, Plymouth. 40 balloons.

No.934 (County of Devon) (Balloon) Squadron.
(5 flights each of 8 balloons) (40)

(iv) No.14 Balloon Centre, Caerau, Ely, Cardiff, Glam. 16 balloons.

No.935 (County of Glamorgan) (Balloon) Squadron.
(2 flights each of 8 balloons) (16)

5 No. 33 (Balloon Barrage) Group.

Headquarters - 3, Windsor Terrace,

Newcastle-upon-Tyne.

(i) No.15 Balloon Centre, Long Benton, Forest Hall, Newcastle-upon-Tyne. 88 balloons.

No.936 (County of Northumberland) (Balloon) Squadron.
(4 flights each of 8 balloons) (32)

No.937 (County of Northumberland) (Balloon) Squadron.
(4 flights each of 8 balloons) (32)

No.938 (County of Northumberland) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

/No.16

(ii) No.16 Balloon Centre, Hemsworth, Norton, Sheffield. 72 balloons.

(Opens 15th August, 1939).
(Temporary address:-
Bridge Street, Sheffield).

No.939 (West Riding) (Balloon) Squadron.
(3 flights each of 8 balloons). (24)

No.940 (West Riding) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

No.941 (West Riding) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

(iii) No.17 Balloon Centre, Sutton-on-Hull, Hull. 72 balloons.

No.942 (East Riding) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

No.943 (East Riding) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

No.944 (East Riding) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

(iv) No.18 Balloon Centre, Bishopbriggs, Glasgow. 88 balloons.

(Opens end of August, 1939).
(Temporary address:-
175, Bothwell Street, Glasgow).

No.945 (City of Glasgow) (Balloon) Squadron.
(4 flights each of 8 balloons) (32)

No.946 (City of Glasgow) (Balloon) Squadron.
(4 flights each of 8 balloons) (32)

No.947 (City of Glasgow) (Balloon) Squadron.
(3 flights each of 8 balloons) (24)

/Section 12.

SECRET

SECTION 12.

FURTHER EQUIPMENT TROUBLES.

(a) Production of Lethal Devices.

S.40711. Encl. 94A.

Before the Air Defence Research Committee of the Committee of Imperial Defence had recommended in May, 1938, that all balloon barrages should be lethal, several attempts had been made to devise some practical means of ensuring that an aeroplane that came into contact with a balloon cable should be destroyed. As a result two schemes had been produced. These were known as the Interval Mass Link and the Double Parachute Link.

Interval Mass Link Unit.

The Interval Mass Link unit was the more complicated of the two, and consisted of some 30 or 40 bombs which were attached to the balloon cable. It was specially designed to combat aircraft fitted with cutting devices, but never went into active production. In September, 1938, when the design of the bombs had been approved by the Royal Ordnance Factory and the Royal Aircraft Establishment, instructions were given to Messrs. Smith Meters, Ltd. to make 25 units by hand methods and prepare tools for production in quantity. Although the limitations of the scheme in comparison with the simpler Double Parachute Link method of arming were displayed in subsequent experiments, the Interval Mass Link project was not immediately abandoned and it was suggested in March, 1939, that a development order for some 400 units should be given to permit of service trials.

S.46412. Encl.5A.

Ibid. Encl.21A.

Ibid. Encl.31A.

At a conference held on balloon wastage on

/13th

13th October, 1939, the difficulties experienced in fitting Interval Mass Link units were discussed, and it was decided that this scheme should proceed on low priority, but that parallel research should be initiated to find a means of arming cables which would not have its operational disadvantages and yet would counter the cable cutters that it was anticipated would be fitted to enemy aircraft.

Ibid. Encl. 33A.

When this decision was communicated to the Research Department, Exeter, which had been responsible for the research, the Department suggested that the scheme could be made operationally successful if a new winch were designed which would take a cable to which the units could be fitted without the use of wedges and also operate in such a manner as to avoid the premature firing of the units. The Royal Aircraft Establishment, however, considered that the suggestions of the Research Department were impracticable and the Interval Mass Link scheme in its original form died a lingering death.

Ibid. Encl. 35B.

Double Parachute Link Unit.

Meanwhile, more successful progress was being made in the development of the less cumbersome Double Parachute Link scheme, which was based on the hypothesis that an aircraft striking the normal type of balloon cable would break it at some point of its length. To circumvent this, a cutting device was fitted to each end of the standing part of the cable; above the cutting device at the top of the cable, and below it at the bottom, was fixed a bag containing a parachute; the parachutes, in turn, were attached to the cable in between the cutting devices and as near to them as possible. When an aircraft struck the cable, the force of impact sent a

/tension

tension wave up and down it causing the cutting devices to sever it at either end before the aircraft had time to do so at the point of impact. The aircraft thus carried away the major (central) portion of the cable pulling the parachutes attached to both ends from their bags. The parachutes opened and the resultant drag on the towing aircraft was more than sufficient to cause it to stall and crash.

The equipment consisted of two units each comprising parachute, bag and link; the link housed the cutting device, and was rapidly clamped to the cable when paying out the balloon. The weight of the two units was about 30 lbs.

With the natural idea of making lethal the fullest length of cable, the units were attached as near to the balloon and as close to the ground as practicable. Experience showed that the best position for the upper unit was about 100 feet below the balloon and for the lower unit about 200 feet above the ground, but depending on the immediate surroundings such as trees or high buildings.

DESTROYED
S.42954.
Encl. 1A.

Experiments conducted in 1937 revealed that parachutes 8 feet in diameter when towed at 300 mph exerted a force of 3½ tons, and accordingly the Royal Aircraft Establishment recommended that parachutes of this dimension should be used for the Double Parachute Link scheme with cable of 3¼ tons breaking strain. An order was subsequently placed with Dunlops for 500 of these which were called, for reasons of security, heavy duty parachutes. The Royal Aircraft Establishment also reported that a design of an inertia link fitted with a .22 cartridge had been approved and had withstood tests in rough weather. An order was

S.43997.
Encl.20A.

Ibid.
Encl.22A.

/placed

placed for 500 inertia links (to be manufactured in accordance with designs submitted by the Royal Aircraft Establishment) with Messrs. Farmers of Coventry, at a cost of £4. 12. 0d. each, and also for 250 drifts[1] and 500 grips.[2] At the instance of the Royal Aircraft Establishment, action was taken in December, 1938, to complete the 500 Double Parachute Link sets by ordering the other necessary components, and additional orders were placed for 1,000 links. Deliveries to Cardington, where the units were assembled, were very slow and, at the request of the Air Officer Commanding, Balloon Command, a weekly report was despatched to him from the Balloon Development Establishment at Cardington showing the number of the various components and accessories in hand, and the number of sets actually assembled and ready for despatch when required. The first report dated 21st March, 1939, gave the receipts of Double Parachute Link components to date as:-

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S.42954
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S.43997.
Encl.31A.

Quick Release Links	- 110
Grips	- 110
Drifts	- 55
Rubber Bands	- 500
Parachutes, Special Heavy Duty	- 1,090
Bags for Parachutes	- 1,090
Cases, Storage	- 150
Rings, Aeroplane	- 190

while 13 sets had been completed in the workshops.

/Apart

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1. Special tools which enabled the securing wedges to be driven properly home.

2. Wedge housings.

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S.42954.
Encl.88A.

Apart from the slowness of output, other difficulties attended the production of this equipment. It was found that the wedges manufactured for the original KB5 cable would not fit on the KB5A and KB5B cables which were coming into use. In consequence it was necessary to arrange for the modification by the Royal Aircraft Establishment of all links already delivered, as it was found that wedges supplied could be used for both KB5 and KB5A cables if the links were modified. Another problem was the discovery that the cartridges being produced by Imperial Chemical Industries became ineffective if exposed to damp, and existing orders were held up pending tests in waterproofing. Balloon Command also asked for a slight reduction in the diameter of the detonator in order to facilitate removal which had been found difficult in bad weather and darkness, and for tests to be instituted by the Royal Aircraft Establishment to determine the effective life of detonators under exposed conditions.

Ibid.
Encl.99A.

Ibid.
Encl.126A.

Ibid.
Encl.140B.

Ibid.
Encl.158A.

Tests of cable cutters revealed that the cutters delivered were not sufficiently hardened and that the cutting edge had been left so soft that it would not cut the cable as intended. The springs of the links were found to be too sensitive in operation and the Research Department consequently devised springs operating at an impact of 100 m.p.h. instead of 40 m.p.h, which would reduce the danger of accidental firing of the unit. This change meant that strikers already supplied would have to be modified and the Research Department arranged for all strikers to be sent to a firm in Exeter for modification.

Ibid.
Encl.171B.

Ibid.
Encl.175A.

/It

It was also reported that the jaws of the Double Parachute Links opened up and became ineffective after wedges had been inserted several times with a drift and block, and a clamp was later invented to do away with this difficulty.

Ibid. Encl.189A.
Ibid. Encl.173B.

A further complication was that the soft-lined wedges supplied were found to be worn out after about 30 fittings. For this reason and because of the tendency of the springs to operate when the cable jerked, the limited number of Double Parachute Links fitted to balloon cables were removed on 5th October, 1939.

S.2148. Encl.18A.

Faced with this situation, a conference held on 13th October, 1939, to discuss balloon wastage agreed that -

> "the D.P.L. device was not yet operationally efficient and it could not be used in service until considerable improvement had been made. The Royal Aircraft Establishment must continue with the utmost speed with their experiments to overcome the troubles."

These inevitable teething troubles delayed supply and caused much adverse comment on the situation. In September, 1939, the Air Officer Commanding, Balloon Command, had expressed concern at the slow rate of deliveries of Double Parachute Link equipment. He stated that only 440 sets had been received out of a total of 3,000 ordered and that the estimated rate of production was much too slow to equip barrages in a reasonable time. He asked for action to be taken to bring the initial issue of Double Parachute Link equipment to two sets for each balloon throughout the barrage and to speed up production without undue regard to cost, so that the 3,000 sets should be available by 31st October.

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S.43997. Encl.110A.

/Provision

Provision should also include a reserve of 1,500 sets and a 15% reserve of spare parts of the main components.

Ibid. Encl.117A.

In December, 1939, the requisitions for Double Parachute Link equipment were substantially increased. But the shortages of supply continued and in June, 1940, the Air Officer Commanding, Balloon Command, stated that he viewed the supply position with alarm; he thought that he would only be able to arm 1,400 balloons by the 31st July and anticipated that from 1,800 to 2,000 balloons would be flying by that date. In a subsequent letter on 16th July, 1940, complaining of shortages of cramps for fitting Double Parachute Links, the Air Officer Commanding, Balloon Command, said that at the existing rate of delivery of equipment a further six or eight months would elapse before the number of balloons then flying could be armed.

Ibid. Encl.132A.

Ibid. Encl.166A.

Ibid. Encl.185A.

In August, 1940, the shortage of lethal equipment came to the notice of the Prime Minister who required details of the position to be placed before him. As a result, every effort was made to accelerate the production of the orders already placed, and another 1,000 units were ordered from Messrs. Rose Brothers, Gainsborough, while those concerned were instructed to give priority to the assembly of sets at the maintenance unit affected.

In addition to shortage of whole units, there were no available spare parts, since all parts supplied were required for the completion of units for the initial issue. The position was aggravated in October, 1940, when Balloon Command stated that, as a result of losses sustained in gales and at the rate of deliveries then being made,

Ibid. Encl.217A.

/the

the initial issue would take months to complete, while the making-up of the establishment of spare parts would take even longer. It was urged that every effort should be made to increase the existing inflow of equipment by 500%. In reply to still further requests, the Director General of Equipment reviewed the whole question of equipment and raised new requisitions for increased supplies, while the Ministry of Aircraft Production promised a substantial increase in deliveries in the near future.

Ibid. Encl.238A.

(b) Supply of Hydrogen for Provincial Barrages.

As soon as the plans for the extension of the barrage to the provinces were approved in 1938, it became obvious that further arrangements for the supply of hydrogen would have to be made, as those existing for the London barrage could not cope with the extra demands. The position then was that plans had been made for the supply of 4,000,000 cubic feet a week each from the Runcorn and the Billingham works of the Imperial Chemical Industries, Ltd., and for 2,500,000 cubic feet weekly from the Royal Airship Works, Cardington.

DESTROYED S.45887. Encl.13A.

It was now proposed to make Cardington the main source of London supply by raising its output to 4,500,000 cubic feet a week by an expenditure of £100,000 on additional plant. In order to supply the midland barrages the capacity of Runcorn was to be increased to 8,000,000 cubic feet weekly, and a new source of supply in the west country found for the western and southern barrages, capable of producing 2,500,000 cubic feet weekly. As Billingham was considered vulnerable to enemy action, it was not to be regarded as a main source

E.P.M.143. 31/10/38.

/of

of supply but only as a standby, although its capacity could easily be increased. It was reckoned, however, that the total output of the other factories would be sufficient to provide all the hydrogen required.

The difference in the cost of hydrogen supplied by Cardington on the one hand and the Imperial Chemical Industries factories on the other is so disproportionate on the face of it that a word of explanation is necessary. At Cardington the cost per 1,000 cubic feet was £1. 9. 5d. including 3/6d. for compression into the cylinders, while the Imperial Chemical Industries charge was only 4/6d. for the same service. The answer is that the Cardington plant was built and run exclusively for the production of hydrogen, whereas at Runcorn and Billingham the gas was a by-product of manufacture and normally blown to waste or discharged to air.

DESTROYED
S.45887.
Encl.24A.
12/12/38.

Although Billingham was not considered by the Air Staff a safe source of supply, it was discovered that by an expenditure of only £7,000, its capacity could be increased from 4,000,000 to 12,000,000 cubic feet a week, and financial sanction from the Treasury Inter-Services Committee was sought for this expenditure on the grounds that the supply could be regarded as a useful reserve in case of the failure of other sources. The work required could be done in two months and the factory output available could be used, if an emergency occurred, before the other schemes were ready. Moreover, the use of Billingham instead of Runcorn to supply hydrogen for barrages at Glasgow, Hull and Newcastle would mean a substantial saving of motor transport. Sanction was also requested for the expenditure of £50,000 on the

/Runcorn

Runcorn works to increase the capacity from 4,000,000 to 8,000,000 cubic feet weekly. In January, 1939, these proposals were approved and Imperial Chemical Industries authorised to make extensions accordingly.

Ibid. Encl.27B.

In February, additional plans were made for increasing the supply of hydrogen at the Imperial Chemical Industries works, Weston Point, Runcorn, by conveying hydrogen by pipe line from the same Company's works at Rock-Savage. To deal with this increased supply, three compressors, believed to be the largest of their kind in the world, would have to be installed there, capable of a pressure of 5,500 lbs. per square inch. Similar compressors were also to be erected at the Widnes works of the Imperial Chemical Industries and, as transport facilities for hydrogen might well be interrupted by enemy action in time of war, it was thought that storage facilities should be increased at both these factories. The extra expenditure for these purposes was also approved, bringing the total cost for all installations at Imperial Chemical Industries works to £90,000.

Ibid. Encl.41A.

Thus, it was expected that between them the three Merseyside works would be producing 8,000,000 cubic feet of hydrogen a week by September, 1939; Billingham 12,000,000 by April, 1939, and Cardington 4,500,000 by July, 1939.

C.I.D. 27th Progress Report. (Feb/Mar. 1939) by Air Ministry.

The additional source of supply for the western and southern barrages was to be at Weston-super-Mare gas works, where plant was to be erected by the Imperial Chemical Industries at a cost of

£85,000

E.P.M.115 (39) Balloon Barrage Progress Report 30/6/39.

£85,000 and capable of producing 2,500,000 cubic feet a week by the end of 1939.

Thus, at the outbreak of hostilities in 1939, plans had been made, but not completed, for obtaining what were considered ample supplies of hydrogen for all barrages from Runcorn and Billingham, Cardington and Weston-super-Mare.

E.P.M. 166. 2/5/39.

The idea of using mobile silicol plants for the production of hydrogen, which had been rejected on the first organisation of the London barrage, was again raised by the Air Member for Development and Production at the Expansion Progress Meeting held on 2nd May, 1939. He pointed out that as one such plant could inflate a balloon in twenty-four hours, a considerable number of hydrogen cylinders, then in short supply, would be saved if twelve available silicol plants were renovated and brought into use.

E.P.M. 167. 9/5/39.

At the following meeting it was decided that this should be done and silicon purchased. Estimates were

E.P.M. 168. 16/5/39.

prepared for the repair of the plants, and it was arranged that 70 tons of silicon should be transferred from India and further supplies ordered.

E.P.M. 169. 22/5/39.

A stock of 28½ tons of silicon, sufficient for immediate needs, existed at Cardington, and a further 300 tons ordered which would suffice to inflate 750 balloons. It was, however, decided shortly

E.P.M. 170. 6/6/39.

afterwards that as sufficient hydrogen cylinders would be available for barrages before the silicol plants had been renovated, the 300 tons should be kept as a reserve.

(c) Establishment of Motor Transport.

As the degree of mobility required and the final organisation of the barrage were not determined in 1936, all estimates of the amount of motor

/transport

transport required for the barrage were bound to be tentative. In addition, it had not been decided whether hydrogen was to be conveyed to war sites.

S.38651. Encl.7B. 18/7/36. The first proposals for transport for a squadron of 45 balloons were one staff car, five 3-ton tenders, and two 5 cwt. light vans. During exercises six tenders would be provided to convey hydrogen and three additional 5 cwt. vans for general transport.

Ibid. Encl.17A. Objection was soon made that six hydrogen tenders would not suffice to inflate 45 balloons quickly. At first, it was considered that sufficient mobility could be attained by mounting winches on trailers and assigning one prime mover for towing to each flight of 10 balloons. But when the organisation and establishments had been further considered, complete mobility was secured by mounting each winch on a prime mover.

Ibid. Encl.26A.

Ibid. Encl.51A. Estimates for motor transport amounting to £360,000 were submitted to the Treasury Inter-Services Committee on 17th February, 1937.

The proposed establishment was:-

For group headquarters.	1 staff car. 1 light van.
For four centres.	4 staff cars. 4 ambulances. 4 heavy tenders. 4 breakdown lorries.
For ten squadron headquarters.	10 light vans. 50 heavy tenders. 10 motor cycles.
For fifty flights.	450 winch lorries. 450 trailers. 50 motor cycles. 100 bicycles.
For mobile silicol plants.	10 heavy tenders.
For reserve transport.	8 heavy tenders. 10 winch lorries.

/Against

Against the total expenditure, a certain small amount of transport had already been allocated to the first barrage unit, and some vehicles intended for the Abyssinian emergency could be utilised. This expenditure was authorised by the Treasury Inter-Services Committee on 20th April, 1937.

Ibid. Encl.61A.

As the organisation of the barrage proceeded and the conditions of deployment were more clearly envisaged, it became apparent to the Air Officer Commanding, Balloon Command, that this scale of transport would not suffice and, accordingly, in November, 1938, he applied for an amended establishment. He required a greater number of trailers to cope with the heavier cylinders in use, and a greater reserve of transport, and asked that the scale of transport should be built up from what he considered the basic unit, the flight. Vehicles found surplus after deployment, when many more vehicles than in subsequent stages would be required, could be returned to the Royal Air Force pool.

Ibid. Encl.72A.

Although the suggestions for an amended establishment were not accepted and the squadron was to remain the basic unit, a new scale was formulated for the London and provincial barrages as follows:-

Ibid. Encl.73A.

For centres.	1 staff car. 2 tractors, Fordson. 2 freighters, Karrier Bartram. 1 ambulance. (in war time 1 ambulance would also be assigned to each squadron). 1 breakdown lorry. 2 motor cycles.
For squadrons.	1 staff car. 1 5 cwt. van. 3 tenders, 3-ton, Fordson Sussex. 2 motor cycles.

/For

For flights. 1 van, 5 cwt.
1 van, 15 cwt.
1 motor cycle.
2 bicycles.

The establishment of trailers for hydrogen cylinders was to be:-

(i) 1 trailer. 30 new type cylinders a balloon.

(ii) 1 trailer. 36 old type cylinders a flight for topping up purposes.

(iii) 3 trailers of 30 new type cylinders per squadron for first reserve to inflate balloon casualties until lines of communication supply commenced to work.

There was also to be an establishment of six-wheeler 3-ton tenders to act as lines of communication vehicles for the conveyance of hydrogen, and the numbers varied in accordance with the distance of the centre from the supply. Finally, one portable cooker capable of feeding 120 men was to be supplied for each flight, and reserves of 60 winches and winch lorries and 60 trailers were approved.

The Air Officer Commanding, Balloon Command, regarded the scale as dangerously inadequate, both for deployment and maintenance. He considered that the provisions for hydrogen transport were insufficient and that extra vehicles would be needed to relieve the winches of some of the equipment and personnel they were supposed to carry, in addition to towing a trailer, and also that more vans would be needed for purely flight transport.

Ibid. Encl.80A.

The objections of Air Vice Marshal Boyd were, however, overruled, the arguments against additional transport being based on the assumption that it would only be needed during the actual period of deployment and would be unnecessary afterwards, as any strategical mobility of barrages was not contemplated.

Ibid. Encl.83A.

/In

In Air Ministry Memo 377 dated 13th February, 1939, a further scale of transport, with some additions considered necessary in the light of experience, was submitted to the Treasury Inter-Services Committee for approval. But the Air Officer Commanding, Balloon Command, was still dissatisfied and returned to the attack in May, 1939, in a letter which described the transport approved by Air Ministry for Balloon Command as -

Ibid. Encl.86A.

> "unsuitable, disproportionate and inadequate."

Basing his demands on the nucleus of flight requirements, he advocated an establishment of two 3-ton tenders a flight, a 15 cwt. van at squadrons, two Fordson tractors, two 3-ton tenders, and a 15 cwt. van at centres. In reply, the Air Ministry still refused to calculate transport requirements on a flight basis and considered that trial should be made of the existing establishment before further demands were submitted.

Ibid. Encl.91A.

Ibid. Encl. 100A.

In answer to this, Balloon Command carried out various tests and submitted the results to Air Ministry to support the case for increased transport. In the course of these tests, a tender and trailer from a centre visited all sites in a flight, times being checked; the time taken for the deployment of crews during the embodiment of June, 1939, was also checked and police opinion obtained about the traffic conditions that would prevail during the first four days of hostilities.

Ibid. Encl. 103A.

The London barrage was expected to cover three phases; the flying of 50 balloons within 1½ hours of an emergency, the deployment of a second 50 in six hours, and the remaining 350 within

/forty-eight

forty-eight hours. The Air Officer Commanding, Balloon Command, was doubtful, in view of the results of the experiments carried out, whether the third phase could be completed without additional transport.

The pertinacity of Air Vice Marshal Boyd, backed by the results of his trials, brought the whole matter again under review, and it was fully discussed at a meeting held at the Air Ministry on 2nd August, 1939. Little progress was made, however, though it was conceded that the medical officer at each squadron should be allowed one 5 cwt. van. No conclusion was reached over the proposal to allot two 3-ton tenders to a flight, and it was decided that Balloon Command should carry out a full deployment test, submitting the results for examination. Air Vice Marshal Boyd recorded his dissatisfaction with the decisions of the conference and considered that further tests to substantiate his demands were unnecessary. More discussions followed and the Director of Organisation finally gave a ruling that one 3-ton tender should be allowed to each flight and one additional 15 cwt. van to each flight, and also to each squadron. While the increase in 3-ton tenders was intended to be permanent, the increase in 15 cwt. vans was only a temporary measure and the vehicles were to remain on loan until adequate reasons for their retention were provided.

Ibid. Encl.106A.

Ibid. Encl.107A.

Ibid. Encl.115A.

Ibid. Encl.118A.

/Section 13.

SECTION 13.

EMBODIMENT OF THE AUXILIARY AIR FORCE BALLOON SQUADRONS.

CS.1214.
Encl.1A.

On the 28th April, 1939, the Chief of Air Staff convened a meeting to discuss arrangements for the balloon barrage in relation to a scheme the War Office had prepared for the manning of guns and searchlights on the basis of conscription. To cover the period until the conscripts were ready, the War Office proposed to call up the anti-aircraft units of the territorial army under powers given by the Reserve and Auxiliary Forces Bill which was about to be introduced. These territorial army units would be called up in four batches, each serving for one month. This would increase the readiness of the defences by shortening the time required for the deployment of guns and lights.

While the auxiliaries could be called up in the same manner as the territorial units, some other arrangement for a permanent basis was required.

Since conscription would form no part of the personnel system of the Royal Air Force, and since it would be impossible to ask auxiliaries to undertake any permanent measure of service in peace time, the Chief of Air Staff thought the only solution was to increase the number of regulars in the balloon squadrons; his proposal, therefore, was that a sufficient number of regulars should be employed to enable a given proportion of the barrage to be manned permanently. This would correspond to the proportion of guns and lights determined by the Home Defence Committee. These proposals, at present, would only involve the London barrage, but

/it

it would be necessary to extend the scheme to the provinces as soon as possible.

The Chief of Air Staff's suggestion was agreed to and, on the 1st May, a further meeting was called by the Deputy Chief of Air Staff to discuss the best methods of putting it into effect. The Deputy Chief of Air Staff explained that it would be necessary to include 100 balloons in the nucleus defence scheme. In consequence, sufficient auxiliaries would have to be embodied at any one time to enable two balloons per flight to be deployed. The meeting decided that this could be achieved by deploying the embodied crews for forty-eight hours at war sites once a week, only half the balloons being deployed at a time. As a result, 50 balloons would be deployed at war sites on four days of each week and each crew would spend two days on its war site and five days on flying training at the balloon centres. After four months all balloon sites would, therefore, have been occupied.[1]

Ibid. Encl.2A.

The training problems which the embodiment involved would result in an increased consumption of hydrogen, and this would have to be controlled so that the state of readiness of the whole barrage would be:-

50 balloons able to fly in 1½ hours.

100 balloons able to fly in 6 hours.

250 balloons able to fly in 48 hours.

400 balloons able to fly in 10/12 days.

/It

1. It was considered essential that balloon crews should have access as necessary to war sites, and a bill was about to be presented to the House of Commons to give powers for this purpose. In theory the Air Ministry already had powers as regards access to land, but the additional powers would do away with the necessity of applying to Justices in Petty Sessions for an order for possession in cases where owners and occupiers were unwilling to grant possession.

It would be desirable, also, to embody squadron commanders and their staffs for the first week in each month during the preliminary period in order to start the new crews on their month's embodiment.

Auxiliary personnel would be placed on the lodging list and would go home at a fixed hour every night, except those crews which were manning balloon sites. Arrangements would be made for calling in these personnel through the telephone service and the police should an emergency arise when they were off duty.

Recruiting, Training and Accommodation for the Regular Airmen.

The scale of nucleus defence for the provincial barrages was to be similar to that for London, namely, two balloons per flight. The total number of regular balloon personnel required, therefore, would be in the neighbourhood of 900 men for the London barrage and 2,250 for the provincial barrages.[1]

In order to release the Auxiliary Air Force personnel it was decided that regular recruits should be trained at the London centres. Until such time as huts became available they would live in tents. The regular balloon operators for the provincial barrages were to be trained at Cardington commencing with 1,000 recruits on the 8th August, 1939. These would be available for posting by mid-December, 1939. The second 1,000 recruits would then start training and would be available for posting by the 1st May, 1940. The final 250 would be trained from this date.

/Deployment

1. These figures were exclusive of administrative personnel, such as N.C.Os., cooks, medical orderlies, etc.

Deployment Plans.

S.54450. 30GP/ S3100/26/ Air. 19/5/39.

By the 19th May, 1939, the Air Officer Commanding, No. 30 Group, had prepared his plans for the embodiment of the Auxiliary Air Force personnel. These were put into effect on the 12th June. All squadron and flight headquarters were established and manned; the squadrons by three airmen and the flights by either two or three airmen. At the same time one balloon crew proceeded with its full equipment to the site to which it was detailed in the event of war. The site was fully occupied and prepared for action including, where practicable, the putting down of a star balloon bed.[1] At the end of three days this crew, together with its equipment, was withdrawn to the balloon centre and a second crew was similarly deployed to another site. These deployments to, and withdrawals from, sites were so timed that one balloon per flight could always be flown within 1½ hours from receipt of orders.

(a) Officers.

The commanding officer and three squadron headquarters officers were required to serve for a week at the beginning of each monthly period[2], while at least one flight officer was serving at all times during the embodiment.

(b) Accommodation.

The squadron and flight headquarters were established in buildings ranging from public houses to sports pavilions, and for this purpose squadron

/commanders

1. An octagonal star-shaped anchorage of cables secured to the ground by screw pickets and forming a mooring which enabled balloons to be made fast into wind at eight points of the compass.

2. In fact, most officers served two or more weeks each month.

commanders were authorised to incur a maximum expenditure of £5 a day for each headquarters as well as a maximum of 4/6d. a day for each man accommodated.

The balloon sites were divided into three categories:-

(i) Sites at which a bell tent could be pitched alongside the winch for the accommodation of a guard of three airmen which was always mounted when a balloon crew was deployed, the rest of the crew being billeted within 200/300 yards of the site.

(ii) Sites at which it was not possible to pitch a bell tent alongside the winch. Here, the guard had to use the winch cab as accommodation, while the remaining members of the crew were billeted 200/300 yards away.

(iii) Sites at which it was not possible to billet the crew 200/300 yards away and at which two bell tents were pitched alongside the winch for the accommodation of the whole crew.

(c) Feeding.

All feeding of the crews[1] was carried out at flight kitchens, established in marquees pitched in the most convenient situations near their flight headquarters. The food was distributed to sites by ration cycle. Auxiliary Air Force officers were paid subsistence allowance and accommodated and fed themselves.

/(d) Employment

1. For further information concerning feeding of balloon crews see pp.

(d) Employment of Permanent Staff.

Concurrently with the training of the Auxiliary Air Force personnel it was necessary to train 90 Royal Air Force recruits per squadron.

No attempt was made to train these recruits as drivers petrol and they were instructed in fabric work and rigging only when balloon flying training was not possible.

First one and then a second crew of nine men per flight were formed and, as far as possible, these men were trained as a crew in the handling, inflation and flying of balloons. None was permitted to drive the winch, this duty being performed by the crew instructor or, failing him, another qualified balloon operator. At first, balloon flying was limited to the areas allotted to each centre. Thus, it was necessary to avoid flying adjacent balloons simultaneously at high altitudes; to utilise the whole of centre areas and fly balloons from suitable positions on roads and tarmac amongst the buildings; to fly balloons outside the centres, but within the flying areas allotted to centres; to allot two or more crews to each balloon and work them in reliefs.

In addition, the stringent economy that was required in order to keep the expenditure of hydrogen to a minimum made it necessary to issue an instruction to the effect that no squadron would at any time have more than ten medium pressure tube trailers or five high pressure tube trailers empty or absent for re-charging.

Embodiment Periods.

The four embodiment periods were planned to be carried out from:-

/11th June

11th June	to	9th July, 1939.
9th July	to	6th August, 1939.
6th August	to	3rd September, 1939.
3rd September	to	1st October, 1939.

During the second embodiment balloon flying from sites was permitted from 09.00 hours on the 28th July until 10.00 hours on the 1st August, when the crews returned to centres.

A further 50 balloons were deployed from centres to war sites and inflated at 11.00 hours on the 1st August and flew until 19.00 hours on the 5th August, when they were deflated. These crews did not return to centres until the crews of the third embodiment were in position on sites.

50 sites were occupied by the third embodiment crews on 6th August and an additional 50 were deployed two days later. These 100 balloons remained deployed and were flown from war sites during the Home Defence Exercises which were held from the 8th to the 11th August. On the 11th August, 50 crews returned to their centres, the remaining 50 being permitted to fly their balloons to 100 feet for the purpose of winch practice and balloon handling.

Full Scale Embodiment.

On the 24th August, orders were issued for the embodiment of the full strength of all squadrons of the London Balloon Barrage, and the balance of the squadrons was embodied and proceeded to their war sites on the following day. By 21.45 hours all sites, squadron and flight headquarters and cooking centres were fully occupied.

On the 1st September at 09.25 hours Headquarters, No. 30 Group issued Operations Instruction No. 1 by broadcast signal to all squadrons.

/This

This read -

"INFLATE ALL BALLOONS."

At 17.00 hours, balloons were ordered to fly at 3,000 feet. One hundred and thirty-five minutes later this height was increased to 4,500 feet.

These instructions were not only governed by the tense international situation that was now holding the nation's attention, but also by the weather. No. 30 Group officers were in fact almost permanently stationed on the roof of Kelvin House observing the weather and studying weather forecasts.

Early the following morning the first casualty occurred to balloons when an over-enthusiastic winch-driver paid out his cable at too great a speed and the cable ran off the drum.

At 12.20 hours on the 2nd September it became obvious that the weather was worsening and that there was a risk of thunder. As a result orders were issued for the close-hauling of eight balloons in each flight.

At 17.25 hours all balloons were again flown to 1,500 feet.

At 21.10 hours the weather once more became unsettled and it was necessary to close-haul the entire barrage.

During the night the weather deteriorated rapidly and thunderstorms raged over and around London, bringing with them incessant rain and lightning. At 03.00 hours a balloon in No. 901 Squadron was struck and destroyed while at the close-hauled position.

/By

By the morning of the 3rd September the storm had abated and at 07.05 hours the barrage was ordered to fly to 4,500 feet. But even while this instruction was being passed the weather again took a turn for the worse and the instructions had to be cancelled and the balloons remained on the ground. They were in this unhappy position when at 11.00 hours the Prime Minister announced that a state of war now existed with Germany.

/Part 2.

SECRET

PART II

BALLOON DEFENCES

1939 - 1945

SECTION 1

THE POSITION AT THE OUTBREAK OF WAR

Shortly after 11.00 hours on the 3rd September, 1939, and almost immediately following the Prime Minister's broadcast, Londoners and residents in Southern England heard for the first time the wailing sirens of the Air Raid Warning System. Although no enemy aircraft appeared, the sirens were sufficient reason for the London Balloon Barrage to be raised to its operational height of 4,500 feet. Barrages throughout the country followed suit. At the end of the day groups reported that some 624 balloons had been flown, of which nineteen had become casualties.

H.Q. Balloon Command Flying Quota.

Balloons had been flown as follows :-

London	444
Birmingham	37
Coventry	11
Derby	2
Liverpool	12
Runcorn	13
Manchester	14
Avonmouth	10
Portsmouth	8
Southampton	11
Plymouth	6
Cardiff	4
Newcastle	9
Billingham	2
Sheffield	14
Hull	14
Glasgow	13

As the barrages were some 800 balloons under establishment, this was a creditable effort and it is reasonable to suppose that had the supply position been envisaged correctly, the barrages would have been up to their full strength by the end of the year. This, however, was not the case. The barrages not only still lacked initial equipment, but it was already becoming apparent that there were not going to be nearly enough balloons to meet the casualty rate which was likely to arise. This had been emphasized by the two days of flying balloons throughout the country prior to the declaration of war, which had made it abundantly clear that the weather, and in particular lightning, was going to cause a great many more casualties to balloons than had been anticipated. In No.31 (Balloon Barrage) Group alone, for example, sixteen balloons had been destroyed by lightning on the afternoon of the 2nd September.(1)

H.Q. No.31 Group F.540.

Meteorological Information

The first problems that presented themselves to the Air Staff therefore were :-

(a) to devise an immediate method of conserving balloons.

(b) to increase the production of balloons.

(c) to plan a long-term policy of balloon conservation.

/As a

(i) An airman of the Liverpool barrage was fatally injured and two more seriously injured when their balloon was struck by lightning on this day. This was the first fatal casualty to occur in Balloon Command.

As a first step towards avoiding casualties it was obviously necessary for the barrage commanders to obtain quicker and more accurate meteorological information.

"Work of the Meteorological Office, Air Ministry in connection with Balloon Barrage Operations."

Prior to the outbreak of war, a meteorological officer had been attached to Headquarters, No.30 Group whenever the London barrage was deployed. In addition, forecasts and warnings were issued to the London balloon centres for training purposes. With the extension of the barrages to the provinces arrangements were made for a continuous meteorological service in the event of war. This consisted of a supply of forecasts and warnings to each barrage from the nearest Type 1 meteorological office. Forecasts were issued four times daily and included "a general inference; forecasts of wind at surface, 1,000 feet, 3,000 feet and 5,000 feet, with special reference to squalls or strong gusts; general weather with special reference to thunder, hail, ice acretion and severe frost; cloud type, height of base or top with special reference to likelihood of large cumulus or cumulo-nimbus; visibility". Warnings of increase of wind and the development of thundery conditions were issued when required at any time. But these arrangements were not satisfactory and the Air Officer Commanding, Balloon Command (Air Vice-Marshal O.T. Boyd) requested the Director of the Meteorological Office, Air Ministry, to provide a meteorologist for each individual barrage to advise the barrage commander on the use of forecasts and warnings and to warn him when dangerous weather conditions were likely. The Air Officer Commanding's request was agreed to in part, a Meteorological Assistant (Grade II), being posted to barrages which were not adjacent to a meteorological observing station from which advice on "local" weather could be given.(1) When meteorological assistants were not established it was arranged that the barrage commander concerned should consult the relevant meteorological office whenever he thought necessary and the forecaster on duty would advise him.

This presented a more satisfactory supply of information concerning the vagaries of the weather and gave the barrage commander time to decide whether he could risk flying his balloons. But there was still a further problem to be solved. The flying policy laid down shortly before the outbreak of war by the Air Officer Commanding-in-Chief, Fighter Command, was that balloons were to fly at all times except when the barrage commander considered that casualties would result from adverse weather conditions. This applied to all balloons throughout the country with the exception of a small number situated in the immediate vicinity of aerodromes, where certain balloons were subject to control by the Station Commander concerned, who was empowered to keep them grounded if by doing so operations from his aerodrome were facilitated.

Thus, the immediate action of a barrage commander on being informed by his meteorological officer that weather conditions were deteriorating rapidly and that he was likely in consequence to incur casualties, was to order balloons to be grounded. While this instruction could be dispatched in a matter of a few seconds, its passage to each individual site was a lengthy business, the whole process sometimes taking as long as an hour to accomplish. This was because communications from flight headquarters to sites were by either a despatch rider or, slower still, an airman on a pedal cycle.

Balloon Command F.540

The consequences of this dilatory system were soon to be brought home in no uncertain manner for, on the 15th September, 1939, it was the main cause of the loss of 78 balloons, all struck by lightning in the London Area.

/Communications

(1) London, Warrington, Coventry, Derby, Hull, Birmingham and Sheffield.

Communications Improved

S.40311
Encl. 81A

This misfortune provoked a letter from Air Vice-Marshal Boyd to the Under Secretary of State for Air, requesting the provision of telephone lines to all balloon sites thereby eliminating delay in the transmission of orders.

Ibid.
Encl. 97A

The Home Secretary (Sir John Anderson) had already received cause to become alarmed at balloon losses, and had communicated with the Secretary of State for Air (Sir Kingsley Wood) pointing out that much damage had been caused to public and private property by the trailing cables of breakaway balloons. Sir John Anderson suggested that these dangers might be avoided if orders to haul down balloons were circulated before dangerous weather conditions set in.

The two communications arriving at the same time clinched the matter, and the Director of Signals placed the requirements of the balloon barrage before the General Post Office. These were that flight headquarters and balloon sites in the same auto-exchange area should be placed on exchange lines, private lines being installed when flight headquarters and sites were in different exchange areas and to all specially controlled sites.

On this basis standard instructions were issued by the Tele-communications Department of the General Post Office so as to ensure the speedy passage of meteorological information, operational and administrative orders from flight headquarters to individual sites. The instructions were later amended to include the installations of switchboards at squadron and flight headquarters.

These arrangements took some time to put into effect, however, and it is necessary now to examine, firstly, the new commitments that were planned for Balloon Command, secondly the balloon production then existing and, lastly, the Air Staff's proposals for the conservation of balloons.

Increase of Initial Equipment

The initial equipment of the barrage already approved at the outbreak of war totalled 1,450 balloons (London 450; provinces 1,000). But by November 1939, the following expansion involving 287 balloons had been planned by the Air Staff:-

	I.E.
Crewe	32
Rosyth	48
Scapa	48
Balloon Training Unit	20
Mobile Barrage	64
Extensions to existing barrages	75
	287

while a further 50 balloons were required by the Admiralty for a shipborne barrage.

The barrage at Crewe(1) was required to give protection to the Rolls Royce works, railway workshops and marshalling yards; the barrages at Rosyth(2) and Scapa(3) to give protection to the fleet; while the mobile barrage was to be formed as a strategic reserve, ready to move at a moment's notice to any given point.

/The

(1) For further information covering the Crewe Barrage and extensions to existing barrages see Section 3. "The Protection by Balloons of Vital Points in the Aircraft Industry."
(2) See pp. 214-216
(3) See pp. 209-214

The extensions to existing barrages were to cover certain factories not already receiving balloon protection. The requirement for the Balloon Training Unit was, of course, for training purposes.

Early in 1940, further balloon barrages were applied for by both the Admiralty and the War Office. The Admiralty asked for barrages in the Thames (1) estuary and at Harwich (2) to combat mine-laying by enemy aircraft, at Plymouth/Avonmouth (3) (Port Z) and at the Kyle of Lochalsh (4) (Port B), where large concentrations of mines were being assembled for operations, while the War Office required balloon barrages at their main base ports at Havre and Boulogne (5). Meanwhile, further extensions to existing barrages and an increase in the allocation of balloons to the training unit had been approved and by April, 1940, the Balloon Command initial establishment had increased by 603 balloons, distributed as follows:-

S.B.4705
Encl.21A

Barrage	I.E. Balloons	Authority
Crewe	32	C.A.S. (File S.2200)
Rosyth	48	C.O.S.(39) 68th Meeting
Scapa	48	W.M.(39) 7th Conclusions. Minute 10.
No.1 Wing (Havre)	24	(War Office requirement
(Boulogne)	16	((File S.59381)
Port "B" (Kyle of Lochalsh)	16	D.C.O.S.(A.A.) 4th Meeting.
Port "Z" (Avonmouth/Plymouth)	18	C.A.S. (Plans 2 folder)
Admiralty	50 + 100 reserve	Admiralty requirement (File SB.1122)
Mobile Barrage	56	Scheme being submitted to the D.C.O.S. Sub-Committee for approval (approved 29/4/40).
Balloon Training Unit	75	Ditto
Thames	24	Admiralty Conference 25/11/39 (1st Lord in Chair).
Harwich	16	Air Ministry signal X226. 22/11 (Defence against Mine Laying).
Extensions		
Harwich	8	D.C.O.S.(A.A.) 7th Meeting.
Tees	24	D.C.O.S.(A.A.) 9th and 10th Meetings
Coventry	8	(D.C.O.S. (A.A.)
Birmingham	16	(10th Meeting
Glasgow	24	(
	603	

/At first

(1) See pp.219-222
(2) See pp.218-219
(3) See page 317
(4) See pp.222-223
(5) See pp.237-245.

At first this expansion was on paper only, the balloons being found by temporarily depleting already established barrages, but before examining how the expansion was in the end achieved, it is necessary to consider balloon production at the outbreak of war.

Balloon Production

E.P.M.118
22/3/38.

When, early in 1938, the prospect of extending the balloon barrage to the provinces came under discussion, the question arose as to the capacity of the balloon industry to deal with now and increased requirements. The original contracts for supplying the London barrage were nearing completion and the two firms concerned, Dunlops and the R.F.D. Company, would be dismantling their plant and dispensing with skilled labour, unless fresh orders were placed.

E.P.M.133
26/7/38
S.46077
A.M. Memo.260

The initial proposals for the provincial barrages were for 1,008 balloons with 220 as reserves, making a total of 1,228, at an estimated expenditure of £675,000 or £550 a balloon, and it was suggested that firms should be invited to submit competitive tenders for the further supply. The Secretary of State for Air, however, did not wish competitive tenders to delay production and it was decided that more firms should be given contracts in order to increase the capacity of the industry.

E.P.M.134
7/9/38.

A.M.Memo.281
6/10/38.

Orders were, therefore, placed as follows:-

Dunlops	140 LZ	type
	360 LZ "c"	type (1)
R.F.D. Company	160 LZ	type
	240 LZ "c"	type
Greengate & Irwell	200 LZ "c"	type
Royal Airship Works	128 LZ "c"	type
	1,228	

DESTROYED
S.46077
A.M.Memo.281
6/10/38.

In addition to the balloons required for the provincial barrages, it was considered necessary to provide a reserve of 1,500 balloons for the whole Command. The Air Council had given further consideration to the question of production and decided that the capacity of the firms already supplying balloons must be increased and other sources created, a start being made by placing an order for 200 balloons with the Lea Bridge Rubber Company.

ibid.
28/9/38.

E.P.M.139
18/10/38.

S.46077 DESTROYED

The subject of accelerating production in order to meet increased demands was again raised at the Expansion Progress Meeting held on the 18th October, 1938, and balloon contractors were invited to submit their proposals for increased production in order to reach a productive capacity of over 200 balloons a month.

E.P.M.143
Progress
Report 30
30/11/38.

Orders had already been placed for 1,978 balloons for the London and provincial barrages and, in order to provide the 100 per cent reserve approved, a further 938 remained to be ordered. Greengate & Irwell were prepared to supply 50 balloons above their present order for 200 by the end of December, 1939. The R.F.D. Company could, by the expenditure of £10,000 on additional premises, increase their output by 120 balloons during 1939. The Lea Bridge Rubber Company was unable to increase production. Dunlops proposed renting certain

/exhibition

(1) The LZ "c" type was made of different fabric but the manufacture of both was to be continued in order to make quicker production possible.

exhibition premises in Liverpool, thus increasing their production to 220 during 1939, and again proposed to extend their Manchester premises, but this proposal was not considered justifiable. Mandlebergh & Company, mentioned as a possible source of balloons in 1936, were prepared to produce 240 balloons a year if additional factory space was provided. These proposals would increase the monthly production of balloons to 239, and on the 21st November, 1938, the Treasury Inter-Services Committee gave them their approval.

Production on these contracts commenced, but although the supply of balloons was in advance of other equipment, the Air Member for Supply and Organisation stated, at a meeting held in April 1939, that it would not be possible to begin building up the reserve before August, despite the fact that existing sources of supply were working to capacity. The chief factor in delay of production was in obtaining fabric from the mills. In reply to the Secretary of State for Air, the Air Officer Commanding, Balloon Command, had intimated that if a crisis occurred in July, there would not be enough balloons to fill the barrages. In the progress report submitted to the Committee of Imperial Defence for February and March, 1939, it was stated that 771 balloons had been delivered, the initial equipment for the provinces would be ready by August 1939 and reserves for all barrages completed by March, 1940.

E.P.M. 66/39

The first calculations as to wastage which had influenced the decision to provide a 100 per cent reserve by no means complied with war conditions, and by October 1939 it was clear that replacements were absorbing all deliveries and leaving nothing for the completion of the provincial barrages. The serious situation caused by the shortage of balloons to complete deployment was brought to the attention of the Under Secretary of State for Air by the Air Officer Commanding, Balloon Command who declared that the deficiency in the provincial barrages was 550 balloons and of reserves 1,360 balloons. The stocks of balloons held, and those due from the manufacturers, were considerably less than requirements. He asked for deliveries to be increased to 600 or 750 a month to deal with immediate requirements.

S.46077 13/11/39

In reply, the Director of Equipment declared that everything possible was being done to secure increased output and that the present target was 500 balloons a month but that owing to the industrial organisation required to obtain this figure, it could not be achieved before March 1940.

E.P.M.187 31/10/39

The increasing demands that would be made on the balloon industry were stressed by the Chief of the Air Staff (Air Chief Marshal Sir Cyril Newall) who stated, on the 31st October, 1939, that the Admiralty required balloons for use on ships and for the protection of bases. The Deputy Under Secretary announced that orders for 4,000 balloons had been approved but that production had reached the limit imposed by the supplies of cotton available.

R.S.B.2436 Encl.5A.

An Air Staff appreciation on balloon barrage policy dated November 1939 cogently reviewed the critical situation which had now arisen. At the outbreak of war it had only been possible to fly some 600 balloons in all barrages and two months later only 641 balloons were flying out of a required total of 1,442. Since the beginning of the war new barrages at Crewe and Rosyth had been supplied with balloons destined for barrages previously planned. Further barrages were now contemplated at Scapa and Havre and the Admiralty had asked for a barrage for sea-going vessels consisting of 50 balloons as initial equipment with 100 in reserve, by January 1940. It was also proposed to establish a mobile barrage of 63 balloons. Over and above these new requirements, extensions to existing barrages were required.

S.45877 Encl.75A

/In all

In all, it was estimated that a total of 3,458 balloons would be required which meant there was a deficiency of 2,695 balloons on existing stocks.

The average wastage since deployment had been 60 a week, amounting to 20 per cent weekly of all balloons flying, and as it appeared that the extreme life of a balloon would be about four to six months, every six months all balloons in use would have to be replaced. Although a production rate of about 450 a month had been envisaged, only 212 balloons had been produced in September, and 148 in October. The shortage of manufactured cotton for the L.Z. "c" balloon meant that the production rate could not be easily increased, and it was considered that any attempt to return to the old type would further disorganise production. Finally, there were 200 balloons awaiting repair at Cardington, where the output of repaired balloons was only one a week.

Thus, it was calculated that the actual rate of production was barely enough to replace wastage without considering the balloons required for other purposes, and that an output of 750 balloons a month was needed to provide for all immediate requirements in the space of two months and build up the requisite reserves in four months.

In order to effect this essential increase, various suggestions were made for stimulating manufacture by increasing the supplies of cotton for balloon fabric, and it was even proposed that balloons should be obtained from abroad.

Every effort was to be made to reduce wastage, and the repair facilities at Cardington were to be increased to turn out at least ten repaired balloons a week.

ibid.
Encl.77A
E.P.M.190
12/12/39.

No sooner had the suggestions been made than the Air Staff note came under discussion at the meeting of the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee, who promptly increased the requirement to 1,000 balloons a month.

These mounting requirements greatly exceeded the productive capacity of the existing balloon industry, and it was decided that greater facilities should be provided for balloon manufacture in the London area where labour was considered to be available. Taking into account the capacity of the existing contractors, to which were now added Elliotts of Cardiff and Littlewoods of Liverpool, it was calculated that production could be raised to 550 balloons a month. In order to bridge the gap between this figure and the desired objective of 1,000 the Air Council sought sanction from the Treasury Inter-Services Committee for expenditure to provide additional facilities for balloon manufacture.

R.S.B.2436
Encl.5A.
A.M.Supply
Memo.25.

ibid.
Encl.7A.

At first it was intended to requisition Olympia, London for this purpose, but the Ministry of Supply forestalled the Air Ministry in obtaining the use of the building. Recourse was then made to the exhibition buildings at Earls Court, but once again the Ministry of Supply was discovered to be in active competition for the same premises. Eventually a compromise was reached whereby the Ministry of Supply used part of the buildings for the manufacture of tentage, and the Air Ministry obtained the remainder for the manufacture of balloons. Their manufacture was placed in the hands of Dunlops, the Air Ministry agreeing to defray the cost of the necessary plant and equipment up to £100,000.

/Conservation of

Conservation of Balloons

S.2148. This shortage of balloons remained extremely serious for some time and resulted in a complete change in flying policy. In November 1939, a suggestion was made by the Air Ministry that a number of balloons on deployed sites should be kept deflated to conserve resources. This proposal was, at first, discounted by the Air Officer Commanding, Balloon Command, who stated that :-

Ibid. Encl.29A. Encl.31A.

> "without wishing to be recriminatory I cannot help feeling that those responsible have failed dismally in their task of producing satisfactory balloons and ballooning equipment and that my Command is now trying to make the best of a bad job ... I think that the real trouble is that all the initiative in development comes from the Command and that B.D.E.(1) who should, I imagine, really be our guides, philosophers and friends in this matter, confine themselves to following rather reluctantly a step or two behind our ideas."

The serious situation demanded radical action, and in an Air Staff appreciation of the balloon defence situation dated the 7th January, 1940, the whole question was analysed and instructions given for its solution. Calculating on a required first line strength of 1,723 balloons, and taking into account that there were 900 flying on 6th January, 1940, it was considered that a production of 674 balloons a month would be required to reach the figure of 1,723 by 1st March, 1940. As the production figure was only about 300 a month, it was obvious that this objective could not be attained.

The problem might be dealt with by carrying on the existing policy of deploying all available balloons and inflating them; deploying all available balloons and inflating none; or deploying a proportion of those available and inflating a proportion of them.

Obviously, there was no hope of building up resources by adopting the first policy; the second left vital areas completely unprotected. The third, however, would gain the desired objective and provide the necessary protection if the balloons were deployed and inflated in accordance with the instructions of the Air Officer Commanding-in-Chief, Fighter Command.

It was considered that 1,428 balloons would be available in the Command up to 1st March, 1940. 1,252 of these should be deployed, 176 being retained to replace wastage. But only 472 of the deployed balloons were to be inflated. This provided a protection in skeleton form for the towns and districts which were to be provided with balloon defences, and there was also a reserve for new commitments and the establishment of barrages at base ports in France.

S.2148 Encl.36A. Thus, on the 13th January, 1940, the Director General of Operations, Air Ministry, wrote to the Air Officer Commanding-in-Chief, Fighter Command, outlining the Air Staff's plans and instructing him to put them into effect forthwith.

/These plans

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(1) The Balloon Development Establishment at Cardington.

These plans, in detail, were as follows :-

Defended Area	No. of Balloons to be Deployed	Balloons Inflated	Balloons Deflated
London	300	100	200
Forth	48	20	28
Harwich	16	16	NIL
Birmingham	109	24	85
Coventry	48	28	20
Liverpool/Birkenhead	44	10	34
Runcorn/Widnes	48	18	30
Manchester	40	14	26
Derby	24	14	10
Bristol/Avonmouth	32	10	22
Southampton	48	30	18
Portsmouth	48	33	15
Plymouth	24	8	16
Cardiff/Newport	4	4	NIL
Newcastle	64	44	20
Sheffield	72	14	58
Hull	56	14	42
Glasgow	44	12	32
Billingham	24	14	10
Scapa	18	9	9
Crewe	32	12	20
Thames	48	24	24
Boulogne	16	NIL	16
Havre	16	NIL	16
Requirement "X" (1)	25	-	-
TOTALS	1,252	472	780

It should be added that the proportion of balloons inflated to those deflated was for the initial period during which conservation was put into effect and the Air Officer Commanding-in-Chief was empowered to vary the ratio at his discretion.

ibid. Encl.43A.

By the beginning of March it was apparent that the conservation policy had achieved the results anticipated. 1,250 balloons were either deployed or in the process of being deployed. Nevertheless, the Air Staff did not consider that any major alteration to this policy was yet justified, except that the full complement of balloons at Havre and Boulogne were to be flying by 1st March, and the barrage destined for Kyle of Lochalsh would also have to be kept flying. At Scapa it was considered that 16 balloons should be flown until circumstances dictated that the approved establishment of 48 balloons was required to be inflated.

The Air Staff estimated that if the proportion of balloons deflated at operational sites was gradually increased during March and April, it would be possible to build up the first line strength of Balloon Command to 1,453 deployed balloons by the 15th May, 1940. They therefore increased the number of balloons to be deployed to this figure.

ibid. Encl.53A

On the 15th May, 1940, the Air Officer Commanding, Balloon Command, informed the Director of Home Operations that the actual figure reached on that date was 1,357 balloons deployed.

/To this

(1) This was a balloon barrage planned for the protection of Trondheim. The failure of our forces to capture this port eventually resulted in the abandonment of the project.

To this figure it was necessary to add :-

Scapa	Balloons ready for flying but delayed by works services and other causes	30
Port "B"	Kyle of Lochalsh. Balloons ready in all respects but flying postponed until 1st June	16
Commitment "X"	Balloons ready in all respects but awaiting orders	18
France	Havre and Boulogne (1)	40

Thus, the task set had been achieved. However, the Air Staff policy of conservation only affected balloons. Other factors had considerable bearing on the matter and the Air Officer Commanding, Balloon Command, stressed that the situation was not nearly so satisfactory as it appeared on paper. For example, only 35 cables of the entire barrage were armed and the completion of arming the remainder was likely to take many weeks; a proportion of the balloons were old and unlikely to withstand strong winds and hot sun; many of the crews under strength and a number of the airmen untrained; ground equipment, including motor transport - on which operations depended - was not yet available in sufficient quantity; huts, anchorages and hard standings, all of which were essential to the efficient working of balloon sites, had been delayed.

In order to assist in building up the barrage Air Vice-Marshal Boyd submitted that matters might be improved :-

> "if a greater trust were put in my judgment as to my requirements, and a greater appreciation shown of the need for haste ... There is a tendency, dangerous at a time of war, to query demands and to rely too greatly on figures of which the interpretation cannot be known beyond my Headquarters."

Air Vice-Marshal Boyd's letter received the attention it merited. It was promptly considered by the Deputy Chief of the Air Staff (Air Vice-Marshal W.S. Douglas) together with a signal from Balloon Command which again stressed the serious position of the barrages. Casualties continued to exceed the rate of production. The Command was losing between 40 and 50 balloons a day against which only 13 balloons a day were being manufactured. The Deputy Chief of the Air Staff sent for Air Vice-Marshal Boyd and together they visited the Under Secretary of State, who in turn, prepared a memorandum for the Secretary of State for Air.

Ibid. Encl. 59A

Increase in Balloon Production

DESTROYED S.62498 M.6

Sir Archibald Sinclair thereupon placed Balloon Command's problem before the Ministry of Aircraft Production, which had recently been formed and had taken over inter alia the responsibility for the production of Balloons. On the 21st June, 1940, the Minister of Aircraft Production (Lord Beaverbrook) submitted a memorandum to the War Cabinet seeking approval for an increase in balloon production up to 20,000 balloons. The Cabinet agreed, deciding the matter should be settled direct between the Secretary of State for Air and the Minister of Aircraft Production. The following day the latter wrote to Sir Archibald Sinclair asking how many balloon winches the Air Ministry required. Sir Archibald Sinclair, in reply, stated :-

/As you

(1) The barrages at Havre and Boulogne were no longer controlled by Balloon Command having become part of the B.E.F.

"As you know we are at present working to a programme of 2,000 flying balloons. This gives us a requirement of 2,000 initial equipment winches with another 1,000 for reserves and war wastage, i.e. a total of 3,000. It is clear, however, that we shall now have to consider increasing the establishment of the balloon barrage as soon as that becomes practicable to cover new commitments particularly in the West of England and in Ireland. This is a question which affects other departments and will have to go the the Deputy Chiefs of Staff, but I think that it would be wise to plan on the basis of an increase of 600 first line balloons and initial equipment wiches with the reserves to correspond."

Following this correspondence, on the 1st July, the Minister of Aircraft Production wrote to the Secretary of State informing him that he proposed to produce 20,000 balloons by the 1st July, 1941. In reply the Secretary of State :-

"As soon as we have the detailed production figures we can calculate the date which we can hope to bring the present barrage up to the establishment of 2,000 flying balloons and how soon it will be possible to undertake an expansion of that establishment."

Further Increases in Initial Equipment.

The plan to increase production to 20,000 balloons envisaged building up to a first line establishment of 2,000 balloons as quickly as possible, thereafter to expand the establishment of 2,600 in order to meet new commitments.

The authorised establishment for the Command at this time was 2,027 balloons. This comprised :-

Operational Barrages	1,902
Training (Balloon Training Unit)	75
Admiralty requirement	50
	2,027

Plans for the additional 600 balloons, though provisional, were as follows :-

At the 17th meeting of the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee, held on the 21st July, 1940, it was agreed that fourteen estuaries should be provided with waterborne balloons as a deterrent to mine-laying. These would require an average of 10 balloons each. The Air Officer Commanding-in-Chief, Fighter Command, wished to establish new barrages at :-

Pembroke	40
Falmouth	24
Ardeer	24
Yeovil	24
	112

In addition, the Air Officer Commanding-in-Chief had signified his intention of increasing the balloon strength of the following barrages :-

Liverpool	+	8
Runcorn	+	4
Manchester	+	16
Bristol	+	4

/Hull

Hull	+ 16
Swansea, Port Talbot, Cardiff, Barry Dock	+ 48
	+ 96

This brought the total from 2,027 to 2,375 initial equipment. But the Air Staff considered it a practical certainty that as soon as the balloon position was more favourable Belfast would require a barrage and were of the opinion that 40 balloons would be the least number that would suffice. In addition, the Admiralty had informed the Air Ministry that if British forces should enter Eire, naval bases would be established at Lough Swilly and the Shannon; and at Berehaven and Queenstown. As balloon barrages had been part of the air defences at every base that the Admiralty had so far established in the United Kingdom it was reasonable for the Air Staff to assume that balloon barrages would similarly be established at bases in Eire. On the assumption that two of the Eirean ports would be fleet bases of the importance of Plymouth and the other two of equal importance to Falmouth it was estimated the requirement would be 128 balloons.

These possible commitments in Northern Ireland and Eire added a further 168 balloons to the initial equipment figure, bringing the total to 2,543 initial equipment balloons.

This left only 57 balloons, out of the total to be established, for meeting any unforseen requirements or miscalculations in the Air Staff's preliminary estimates.

DESTROYED
S.62498
Min.8
22 July 1940

These estimates did not consider the requirements that would eventually arise when Britain resumed military action on the Continent, although the Air Staff, even in those dark days, had not overlooked this possibility and had stated:-

> "we shall ultimately be required to provide balloon protection for the overseas bases on the same scale as that given for the British Expeditionary Force." (1)

The initial equipment of 2,600 balloons was approved on the 29th July, 1940, by the Vice Chief of the Air Staff (Air Marshal Sir Richard Peirse) and balloon production went ahead as planned. (2)

/Formation of

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(1) 24 balloons were provided for both Havre and Boulogne. A further 24 were earmarked for Trondheim, but were not used owing to the failure of our forces to capture this port.

S.62498
M.6

(2) On the 5th July, 1940, the Minister of Aircraft Production intimated that the balloon production programme would be:-

July	-	600
August	-	750
September	-	1,000
October	-	1,200

A subsequent letter from the Minister stated that production after October would be 1,200 balloons a month.

Formation of No.34 (Balloon Barrage) Group

DESTROYED.
S.59581
Encl.1A
14/1/40

With the spread northwards of balloon barrages came problems of administration from a higher level, and the Air Officer Commanding, Balloon Command, felt compelled to ask, in January, 1940, for the formation of a new group to cover Scotland. His suggestion envisaged the balloon groups roughly covering the country in the following manner :-

No.30 Group - London and eastern approaches
No.31 Group - Midlands and north-east England
No.32 Group - South and west England
No.33 Group - North-east England
No.34 Group - Scotland.

The first three groups would remain unaffected by his proposals, while the new group (No.34) would take over the Scottish centres hitherto administered by No.33 Group.

ibid.
Encls.5A, 8A
25/1/40
23/2/40
No.34 Group F.540
S.59581 Encl.22B
17/5/40

The Air Ministry approved the proposal in principle, and on the 19th February the new group began to form in temporary quarters at Newcastle-on-Tyne under the command of Air Commodore H.R. Busteed. Three months later, on the 15th May, the group moved to its permanent headquarters in Edinburgh.

SECTION 2

THE PRACTICAL SIDE OF THE EXPANSION

The expansion of Balloon Command up to July, 1940 has so far only been dealt with from the planning aspect. Putting the plans into practice, however, presented a number of problems that required both time, patience and tact to solve.

Scapa Flow, 1939

11/H/156/2 Encl.2 C.I.D. (H.D.C.)
ibid Encl.14
ibid Encl.15 Encl.19 ibid Encl.20

The first new barrage to be authorised after the outbreak of war was that for Scapa Flow. During the summer months of 1939 when it had been decided that the Flow was to be used as the main base for the fleet, the sub-committee on the re-orientation of the Air Defence System of Great Britain put forward a number of recommendations for strengthening the defences at Scapa by the provision of fighter aircraft. The naval representative, however, considered that the possibility of a long range torpedo attack being made on the fleet anchorage constituted a serious danger, and on the 18th August, 1939, the sub-committee proposed that a balloon barrage should be provided to protect the anchorage against low flying aircraft and at the same time requested the Air Staff to prepare a note on the question of balloon and fighter protection for Scapa. The note, envisaging that some 250 balloons would be required for the purpose, stated that such a barrage could only be supplied by depleting all other balloon defences both of balloons and hydrogen cylinders. The Air Staff, in fact, came to the somewhat depressing conclusion

> "that against the possible scale and form of attack little reliance could be placed on the fighter defence except as a slight deterrent, while the practicability of providing a lethal barrage would seem in present circumstances almost insoluble, though in May, 1940, an adequate barrage and a satisfactory deterrent fighter defence could be provided."

ibid Encl.29

These considerations were abruptly set aside by the decision of the War Cabinet at a meeting held on the 7th September, 1939. It approved a memorandum by the Chiefs of Staff recommending measures for the air defence of Scapa which included the immediate provision of two flights of balloons. These would be provided at the expense of localities for which balloons had already been deployed or approved. The provision of a complete balloon barrage would have to wait until the production and administrative situation permitted.

AHB/II D/34/5/18(A)
~~KBS/853979/Org.~~
Pt.1 Minutes of Conference to discuss Administrative arrangements for provision of Balloon Barrage At Scapa Flow.
ibid. Note on Immediate Provision of Balloon Barrage at Scapa Flow.

In order to implement these decisions the Air Officer Commanding, Balloon Command, decided to withdraw equipment on the scale of two balloon sets from each London squadron. He anticipated that the necessary hydrogen would have to be supplied from Billingham or a silicol plant established at Scapa Flow. For the complete barrage it was now thought that some 152 balloons would be required, partly sited to the east to defend the fleet anchorage from torpedo carrying aircraft, and partly round the fleet anchorage itself as a protection against low flying attack. The initial barrage was to consist of sixteen balloons divided into two flights of eight balloons each and administered as a squadron.

/Squadron Leader

Squadron Leader C.W. Harrison of Headquarters, No.33 (Balloon Barrage) Group proceeded to Scapa to confer with the Commander-in-Chief, Home Fleet, with regard to siting and administrative arrangements.

ibid. Provision of Balloon Defence for Fleet Anchorage at Scapa Flow and the Oil Storage at Lyness.
SB.174 Encl.15A.
Org. Pt.1. Encl.18A.
ibid. Encl.21A.

As the Navy required full freedom of action in the anchorage and Flow, waterborne sites could not be used and thus all balloons would have to be located on the islands of Hoy and Flotta. For the initial phase, four sites were to be situated on Flotta and twelve on Hoy, while an additional thirty-two sites were also found on both islands for use in later phases. Sites were also noted for a balloon centre and for four flight headquarters. This siting was approved by the Vice-Admiral, Orkneys and Shetlands, and co-ordinated with guns and searchlights. A conference held at Cardington in October recommended that hydrogen should be at first supplied by shuttle service from Billingham via Invergordon and that a silicol plant should be erected later in Orkney. No.948 squadron was to be formed at No.4 Balloon Centre, Chigwell, for service at Scapa Flow. (1) Auxiliary airmen were to be asked to renounce their rights as auxiliaries with regard to posting, (2) and to volunteer for service in this squadron.

ibid. Encl.54A.
ibid. Encl.55A.

While these preliminary arrangements were in progress all action on what was now known as the "Q" Plan, that is, the scheme for the defence of Scapa Flow, was suspended. One month later, on 20th November, 1939, Balloon Command was instructed to proceed with the "Q" Plan again in its original form. The initial sixteen balloons at Scapa were to be raised to forty-eight during March, 1940, and a new squadron with the necessary establishment for forty-eight balloons, divided into six flights, was to be formed and to be known as No.950 Squadron. Hydrogen was to be shipped from Invergordon at first, a low pressure type silicol plant capable of producing 1,400,000 cubic feet a week to be erected on Hoy Island, and a main hydrogen plant set up in the north of Scotland capable of producing 2,500,000 cubic feet a week.

DESTROYED
SB.174 Encl.26A.

The detailed arrangements that had now to be made and of the conditions under which the barrage was to operate was given in an administrative report on the "Q" Plan made in December 1939. The Navy had undertaken the weekly shipment of 120 cylinders of hydrogen and to provide small vessels called "puffers" for inter-island transport, and a reserve of hydrogen on Hoy was considered necessary in case of interruption of sea communications. Owing to the narrow roads on the islands and the problems of unloading, it was recommended that small trailers capable of carrying ten cylinders only should be adopted, thus doing away with the use of standard trailers and three ton lorries. Additional pier facilities were to be provided by the Admiralty which also undertook to arrange for the initial landing of the squadron at Lyness on Hoy and the transport to Flotta of the balloons to be deployed. Arrangements had been made for the repair of motor transport, for hospital accommodation, for a rest camp, for water supplies and for messing. It was recommended that each airman should be issued with five blankets, thick gum boots and waterproof clothing.

/The

(1) No.948 Squadron did not deploy to Scapa, being ultimately despatched to Rosyth. See page 216.

(2) See Appendix "M" for conditions of service of Auxiliary Air Force personnel.

The difficulties which would be encountered were emphasised in a memorandum on works and services attached to the report; such roads as existed were in urgent need of widening and repair, landing facilities were inadequate, labour was very difficult to obtain, water supplies were scarce and there were no baths available; lighting would have to be by oil lamps. Taking these difficulties into account, it was considered that at least three months would elapse before the works services essential for the initial deployment of sixteen balloons could be completed.

DESTROYED
~~SB.174~~
Encl.28A.

When instructions were received to put the revised "Q" Plan into operation a further reconnaissance was carried out by an officer of Balloon Command to re-examine the possibilities of balloon protection from waterborne sites and to make a further selection of suitable land sites. It was decided, in consultation with the naval authorities, not to use drifters as waterborne sites, but experiments were to be carried out with a self-propelled lighter. A detailed reconnaissance was made on Hoy and Flotta and a total of forty sites found in all, for some of which new roads would be required. Additional sites could be found if a waterborne barrage was found impossible.

Scapa Flow, 1940

Al/H/156/1
Encl.34 Report of Meeting on A.A. Defences of Scapa Flow. 6/1/40.
~~W.O.H.S./TS/34/5/18(B).~~
~~Air/8539/79/~~
Org.Pt.11
Encl.20A.

At a meeting on the anti-aircraft defences of Scapa Flow held by the First Lord of the Admiralty (The Rt.Hon.Winston S. Churchill) on the 6th January, 1940, it was decided that as Scapa Flow was to be used as a fleet base from the 1st March, 1940, and fleet tenders would begin to assemble there during the previous month, it would be necessary for the initial balloon barrage to be flying by the 14th February. Balloon Command received orders to this effect from Air Ministry and were instructed to fly a barrage of forty-eight balloons by the end of March.

ibid.
Encl.25A.

SB.174 Encl.2A.
~~Air/8539/79/Org. Pt.11.~~ Encl. 25A.

Arrangements were concluded with the Admiralty for the shipment of hydrogen and the transport of the squadron and its equipment to Lyness. It had been previously suggested by the Air Officer Commanding, Balloon Command, that, in view of the weather conditions prevailing in the Orkneys, it would be desirable to fly strengthened balloons there from a stouter cable, but in view of the imminence of deployment it was found impossible to supply the strengthened type of balloons for the initial phase. For the same reason, the standard type of trailer drawn by a three-ton lorry would have to be employed despite the bad condition of the roads on Hoy and Flotta.

ibid.
Encl.56A.

The final establishment of No.950 Squadron (formed for the defence of Scapa) was to be six flights of eight balloons each and was to include airmen who were now being trained in kite flying at Mullion under arrangements made by No.32 Group.

Meanwhile, in the Orkneys, a liaison officer (Flight Lieutenant Read) was endeavouring to overcome the opposition of the naval authorities to the use of the roads by heavy air force transport and the objections of the army authorities to the siting of the projected silicol plant on Hoy.

On the 2nd February, (Wing Commander R. Risk) the Officer Commanding, No.950 Squadron, set up his headquarters at Lyness on Hoy. He had accompanied the third party and had immediately

/reported

ibid. Encl.45A

reported to Balloon Command on the situation he found. He gave a grim picture of the conditions prevailing, showing that it would be difficult, if not impossible, to keep to the programme. The airmen of the advance parties, who had worked admirably, were engaged in erecting huts as the contractors had no general labour available. It had been found impossible to unload much of the equipment on Hoy on account of stormy weather. Concerning Flotta, Wing Commander Risk wrote :-

ibid. Encl.63A.

> "One of the piers has, I understand, been washed away, and although an attempt has been made on three successive days, landing of hutting on Pan Hope Pier has proved for the time impracticable. I had planned to visit Flotta in a drifter tomorrow but it is doubtful if this will be feasible under present conditions."

However, on the 12th February, Wing Commander Risk was able to report that the s.s. "FLORISTAN" had arrived with winches and trailers on board, whilst light vehicles and hutting had already been unloaded and it had been possible to land some twenty men on Flotta. On the 20th February, the fourth party arrived at Lyness with equipment and, on the 22nd February, eight balloons, three from Flotta and five from Hoy, were flown for fourteen hours. The balloons flew from screw pickets and during the next few days a number of casualties occurred, while balloons were bedded, attributable to violent changes in wind direction.

ibid. Encl.101A

ibid. Encl.108A

In his report to Balloon Command of 2nd March, Wing Commander Risk stated that no more balloons could be inflated until concrete beds were completed because the nature of the ground was such that it was impossible to use screw pickets on any more sites. He pointed out that this constructional work would have to be done by the airmen themselves as the contractors had no available labour. This problem was emphasized again when the Air Officer Commanding, Balloon Command, explained to the Air Ministry that the completion of the first phase of deployment at Scapa Flow had been greatly hindered by local conditions and difficulties, among them the fact that concrete beds were necessary on many sites. Despite these handicaps, however, he hoped that, by the end of March, eighteen sites would be occupied, a further twelve by the end of April and the remainder by the end of May. Ignoring the siting details of the two phases, he proposed to fly balloons from all possible sites as soon as possible.

DESTROYED.
SB.174
Encl.43A

AHB/IID/34/5/18(D)
~~KBC/S.53979/~~
~~Org. Pt.IV~~
Encl.24A

By the 27th March, twelve balloons were inflated including two balloons flying from trawlers, the naval authorities having now withdrawn their former opposition to trawlers provided that they remained responsible for laying the moorings, and it was anticipated that a further eleven sites would be ready for occupation shortly. However, at the end of March, severe gales accompanied by lightning and snow interrupted all progress and caused casualties to both waterborne and land-sited balloons.

ibid. Encl.36

It was now decided to extend the barrage by flying a further eight balloons from land sites, two from the island of Gava, four from Fara, and two from Long Hope on Hoy. Fara is a small island in the channel between Hoy and Flotta, and Gava is in the Flow to the north of Fara. In addition, there was to be a barrage of waterborne balloons flying from trawlers.

ibid. Encl.44A

With an increasing number of sites the squadron commander found himself in serious difficulties over hydrogen supplies, which were often delayed owing to the uncertainties of sea transport and the problems of unloading on the congested and limited pier space available.

ibid. Encl.45A

The Admiralty refused to authorise special ships for the use of the barrage, but agreed to provide lighters on to which hydrogen cylinders could be unloaded when pier space was not available.

/During

ibid.
Encl.46D.

During April, 1940, there were several enemy air attacks on the fleet anchorage, directed particularly against the harbour booms. A number of enemy aircraft were destroyed by gunfire, and the squadron commander was satisfied that the barrage had prevented the low flying characteristics of earlier raids.

ibid.
Encl.48A

The proposals for the extension of the barrage at Scapa involved various problems of administration which were set out in a letter from the Officer Commanding, No.950 Squadron to No.34 Group (which had now taken over the administration of the squadron) on the 19th April, 1940. He pointed out that some forty sites had been initially approved for the barrage and since then eight additional land sites had been located on Fara and Cava, while eight sites had been found for balloons flying from trawlers. These increases would demand additions to the original establishment of the squadron, particularly if the trawler balloons were to be considered a permanency in the Scapa barrage. In particular, circumstances had shown that additional aircrafthands were required for stevedore work and an increased number of men in the equipment section. Further accommodation and more transport were also needed. As difficulties over the sea transport of hydrogen still continued and no local hydrogen plant had been erected, Wing Commander Risk asked if two small ships might be allotted for the transport of equipment and hydrogen from a Scotch port to Lynee, thus avoiding dependence upon naval stores ships.

ibid.
Encl.56A

On the 29th April, fifteen balloons, ten from land sites and five from trawlers, were flying, and four balloons had been deflated on the previous evening because of a gale warning. During the night while the balloons had been bedded, kites were flown experimentally for the first time. A 3ft. kite with a 2 ft. kite as pilot was flown at operational height with a weak link between the two. The 2 ft. kite was carried away by the weak link parting but was subsequently recovered undamaged and the experiment was considered successful.

ibid.
Encl.59A

At the beginning of May, No.34 Group was informed by Balloon Command that it had been decided that the Scapa barrage of fifty-six balloons was to be established as a wing of two Squadrons. No.34 Group recommended that the establishment should comprise a balloon centre, a squadron with headquarters at Lyness controlling twenty-eight land sites divided into two flights of eight balloons and two flights of six, and a second squadron on Flotta controlling twenty-eight balloon sites made up of two flights comprising eight land sites each, and a waterborne flight of twelve balloons. Soon after these recommendations were made the Navy asked for an additional four trawler sites which increased the total of waterborne sites to sixteen, but the grand total was kept unchanged by reducing the number of land sites from forty-four to forty. To comply with these demands No.34 Group submitted fresh recommendations to Balloon Command. It was proposed that No.950 Squadron at Lyness should control four flights of eight land-sited balloons, and a new squadron, No.960, should control the sixteen waterborne sites, divided into two flights, and a flight of eight land sites. A trawler base was to be situated at Rinnigill on Hoy where it was intended to erect the hydrogen plant.

ibid.
Encl.10A

ibid.
Encl.25A

Arrangements for accommodation in accordance with these administrative changes were discussed at a conference held on the 3rd August, 1940. Instructions were issued by the Air Ministry that No.20 Balloon Centre would form at Lyness with effect from the 26th August, 1940, to administer

/No.950

ibid. Encl.49A.

No.950 Squadron at Lyness, reorganised into four flights of eight balloons, sixteen situated on Flotta and sixteen on Hoy, and also No.960 Squadron to be formed on the same date and to comprise two flights of eight waterborne balloons based on Rinnigill, and one flight of eight land-sited balloons, five on Fara and three on Cava. A new establishment was to be issued for these formations. As it was found that the pier at Rinnigill was not available for trawlers, it was decided that No.960 Squadron headquarters should be at St. Mary's Pier, Holm, on Mainland. Following decisions taken by the Air Officer Commanding, Balloon Command, after visiting the Orkneys, No.20 Balloon Centre was to occupy the former No.950 Squadron headquarters on Hoy and No.950 Squadron would occupy a site adjacent to this centre.

ibid. Encl.61A.

The Firth of Forth (Rosyth) Balloon Barrage

HCTD/S274 Encl.2A.

On 16th October, 1939, the Air Ministry signalled Headquarters, Fighter Command, that the "Y" Service (1) had reported unusual activity by the enemy, apparently directed towards Rosyth where the battleship "REPULSE" was in dry dock. The Home Fleet was due to arrive at Rosyth on the 21st October, and the Air Officer Commanding-in-Chief was instructed to move one squadron of fighters into the Turnhouse area immediately, and to take all additional measures practicable to strengthen the air defence of the base.

Shortly after the receipt of this signal at Headquarters, Fighter Command, a formation of twelve enemy aircraft attacked the Forth area. These were engaged by fighters which destroyed three and drove the remainder off. It was obvious, however, that Rosyth must have stronger defences, and on the 18th October, the War Cabinet decided :-

W.M.(39) 51st Conclusions M.4.

> "that a committee should be formed to examine as a matter of urgency, the arrangements to be made to provide a secure base for the fleet on the East Coast."

The committee (2) met the same day and were informed that the object was to render Rosyth as secure as possible for use as a fleet base. It was learned that the battleships "NELSON" and "RODNEY" and the battle cruiser "HOOD" must berth eastward of the Forth Bridge owing to their inability to pass under it

/without

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(1) A signal service which intercepted enemy W/T and R/T messages.

(2) The Committee was composed of :-

Chairman: Admiral of the Fleet Lord Chatfield. (Minister for Co-ordination of Defence)

The Rt.Hon. Mr. Winston S. Churchill (First Lord of the Admiralty)

The Rt.Hon. Lord Hankey (Minister without Portfolio)

The Rt.Hon. L. Hore-Belisha (Secretary of State for War)

Admiral of the Fleet Sir Dudley Pound (First Sea Lord)

General Sir Edmund Ironside (Chief of the Imperial General Staff)

Air Chief Marshal Sir Cyril Newall (Chief of the Air Staff).

without housing top masts - a formidable task with modern radio aerials. In any case, it was desirable that all ships using Rosyth should be berthed as close as possible, either side of the Forth Bridge, in order to secure the maximum possible defence. This presented a danger, however, in that should the Forth Bridge collapse under air attack, ships to the west of the bridge might be bottled up. Bearing in mind these considerations, the committee formulated their recommendations for increasing the defences. These included twenty balloons earmarked for Scapa - which for the present was not to be used a a fleet base. This figure was almost immediately raised to forty-eight balloons and the Air Officer Commanding, Balloon Command, was instructed to have a number flying by 12.00 hours on the 21st October.

AHB/IID/34/4/30(A)
~~KBC/S54611/Ops.~~
22/10/39

His first action was to issue instructions for twenty-one balloons of the Glasgow barrage to be deflated and moved to South Queensferry on the south side of the Firth of Forth. Similarly, instructions were issued to No.948 Squadron, which was forming at Chigwell for service at Scapa, to move to Inverkeithing, on the North side of the Firth.

Meanwhile a reconnaissance party was dispatched to Scotland to make contact with the Commander-in-Chief, Rosyth, to arrange the organisation and administrative requirements for immediate deployment. On arrival at Rosyth and after the preliminary arrangements had been agreed upon with the Commander-in-Chief, the party split into two parts, each setting about finding suitable balloon sites, squadron and flight headquarters. The siting of the barrage was somewhat complicated because of:-

(a) The wooded nature of the land.

(b) Poor anchorage due to the nature of the sea bottom in the Firth, the depth of water and tide.

(c) The proximity of Donibristle and Turnhouse aerodromes.

(d) The area required to enable the fleet to manoeuvre to their anchorage and to enter the boom defence.

Owing to the necessity of providing a barrage immediately, the Glasgow squadrons, which began to arrive at 10.30 hours on 20th October, were deployed to sites arranged between Hound Point and Port Edgar Pier. These sites were temporary, however, and the permanent siting plan followed a perimeter plan of two-line density; where possible, the balloons being placed 1,500 feet apart. The plan consisted of seven waterborne sites, seventeen land sites south of the Forth, and twenty-four to the North, of which eight were to defend the dockyard.

Waterborne siting was no easy matter because of the naval requirements and the muddy nature of the anchorage, but three-ton barge moorings were provided, the balloons being flown from 250-ton Humber barges. Nine balloons were flying from the temporary sites by 16.30 hours on the 20th October and by 18.30 hours on the following day this number had increased to twenty-one.

Meanwhile, arrangements had been made by Headquarters, Balloon Command, for No. 929 Squadron to be withdrawn from the Bristol barrage and after being brought up to strength, to take over from the Glasgow squadrons. At the same time a new depot,

/No. 19

No. 19 Balloon Centre, was formed at Rosyth with effect from the 24th October, 1939, to control both squadrons. By the end of October, No. 929 Squadron had taken over from the Glasgow squadrons, and No. 948 Squadron had arrived from Chigwell and had deployed and inflated their balloons. Thus, the barrage was gradually built up and became fully operational early in November.

The Mobile Naval Balloon Barrage

S.2229
M.1
6/10/39

Shortly after the outbreak of war, the Air Member for Development and Production (Air Marshal W.R. Freeman) was informed by an officer of the Naval Staff that the Admiralty was likely to make a demand for sufficient balloon barrage equipment to enable them to erect barrages abroad should any portion of the fleet be detached. This prompted Air Marshal Freeman to write a minute to the Air Member for Supply and Organisation pointing out that as the Air Ministry had now completed their production arrangements for balloon barrage equipment, it was essential that any Admiralty demand should reach him by the 20th October, 1939, giving as many details as possible regarding exact equipment to be provided in respect of winches, hydrogen and balloons, together with the likely wastage figures.

ibid.
M.2
9/10/39

The Air Member for Supply and Organisation knew nothing of the Admiralty requirement and passed the matter to the Director General of Operations. As a result, the Admiralty was requested to furnish the Air Ministry with an indication of their probable balloon requirements. The Admiralty replied on the 28th October stating that in order that additional protection from air attack might be afforded His Majesty's Ships while in harbour, or operating in waters where a heavy scale of attack was to be expected, they were considering the use of barrage balloons, flown from the ships themselves. Fifty balloons would be required as initial equipment. Hydrogen cylinders and winches would also be required, but not motor transport.

ibid.
M.16.
31/10/39

This Admiralty requirement was received with some dismay by the Air Ministry for the general balloon defence of Great Britain had been weakened already by the provision of forty-eight balloons for the protection of the fleet at Rosyth, and more balloons would ultimately be required for Scapa. Production was still far behind the rate of wastage, and established barrages throughout the country were still woefully short of their quota of balloons. Thus, it was not surprising that the head of Organisation 4 (Wing Commander V.R. Gibbs) informed the Director of Home Operations (Air Commodore D.F. Stevenson) that:-

> "we are drawing your attention to the position as these late Admiralty requirements are seriously sapping the efficiency of our barrages planned long past, and we must therefore have instructions as to the order of priority."

ibid. M.43.
9/12/39.
Encl.48A.
15/12/39
SB.1122
Encl.2A
SB.1122

The Admiralty now informed the Air Ministry that they would require 150 balloons together with 4,750 hydrogen cylinders (1) by the 15th December, 1939. The question of whether this demand was to be met or not required a decision from the highest authority, and on the 3rd December, 1939, the Deputy Chief of the Air Staff put the problem before the Chief of the Air Staff, who ruled that the balloons were to be supplied subject to a War Cabinet decision that the

/operation

(1) Representing 30 per balloon and 250 for topping up at sea.

operation for which they were required was to be undertaken. Until this decision was forthcoming the Admiralty was to be provided with ten balloons for training purposes.

(a) Balloons at Sea - Trials

S.2229
Encl.52B.

Meanwhile, the Navy had been carrying out a number of trials in flying balloons from destroyers at sea. The most important of these were undertaken on H.M.S. "NUBIAN", a "Tribal" class destroyer.(1)

Trials were commenced on the 28th November, 1939, when a L.Z. balloon was inflated by an air force balloon crew in Portsmouth Dockyard, transferred to a tug and taken to "NUBIAN" at a buoy. The balloon was close-hauled, the transfer leg removed, and then let up to 500 feet on the winch cable. "NUBIAN" and the tug then sailed for Spithead where the destroyer anchored. Transfer of balloon from ship to tug and vice versa was then practised. The long transferring leg was taken through a snatch block to the remote lead-off and let forward through suitable leading blocks to the winch bollard. The winch driver could not see the lead-off and was controlled from aft by an officer with a flag.

The following day "NUBIAN" proceeded to sea and trials were carried out to determine the maximum safe speed for towing with the balloon at various heights. The wind was about 30 miles an hour. At 1,000 feet, steaming 15 knots into the wind (2) the average tension of 45 hundred-weights was reached. It was considered that for safety the wind speed on the balloon should not exceed 40 miles an hour at this height. At 1,500 feet, 20 knots was the maximum speed which could be attained with safety. (3) This gave a cable tension varying from 20 to 28 hundredweight.

Various data of safe speeds above 1,500 feet had been obtained during earlier trials (4) and the balloon was now close-hauled for topping up. The ship's speed on the beam of about 20 miles an hour. The balloon was easily handled. One cylinder of hydrogen was used to top up and the balloon was raised to 500 feet.

Hauling down was then practised with the ship headed into the wind and going slow ahead, giving a wind speed of about 35 miles an hour. This was found impracticable, however, and liable to damage the balloon. Similar results were obtained while steaming slowly at 40 degrees off wind.

/(b) The

(1) In this class of ship the only suitable position for the balloon winch was on the upper deck before the after super-structure, the flying cable being led through a leading block to a remote lead-off on the quarter deck. With this arrangement the winch driver could not see the balloon attachment when it was close-hauled.

(2) i.e. with a wind speed on balloon of 47 miles an hour.

(3) i.e. wind speed on the balloon slightly more than 50 m.p.h.

(4) See Admiralty letter A/K.B.2 of 9th November, 1939.

(b) The Admiralty Requirement Postponed

ibid. Encl.66A. 20/1/40.

On 20th January, 1940, the Lords Commissioners of the Admiralty informed the Air Council that they had decided to postpone indefinitely the scheme to provide protection by shipborne balloons for the fleet against low bombing attack, and their request for equipment could now be considered cancelled. But the matter was not yet closed. In February, the Admiralty again wrote to the Air Ministry stating that in case their previous communication had implied the final abandonment of the project, they wished to emphasize that this was not so. Their Lordships had, in fact, decided not to abandon the balloon baby for ever, but only for a year. In the meantime they wished the Air Ministry to foster the child and be ready to hand it back, dressed up in its sailor suit, as and when required.

The Harwich Barrage

AHB/IID/34/5/20(A) KBC/S.55291/ Org. Encl. 26A. 22/11/39.

By the middle of November, 1939, some concern was being felt on the question of enemy minelaying activity off the east coast of England, and the Air Officer Commanding-in-Chief, Fighter Command, decided that balloons should be provided as part of the defences against this form of attack in the approaches to the ports of Newcastle, Hull and Harwich. While Newcastle and Hull already possessed balloon barrages and the problem could be met by the establishment of a few extra waterborne balloons, Harwich had no balloons and it was decided that it should be provided with a squadron comprising two eight-balloon flights. This had to be found from existing resources, and No.928 Squadron, Bristol, shorn of one flight which had already been sent to Avonmouth, was detailed for Harwich to fly sixteen balloons. No time was lost in the move in view of the urgency of this form of protection, the vehicles setting forth by road on the 23rd November, while the personnel proceeded by special train on the following day.

Balloon Command F.540 22/11/39. ibid. 23/11/39.

Meanwhile, a party left London to make administrative arrangements as well as to select sites, and began its reconnaissance early on the morning of the 23rd November.

AHB/IID/34/5/20(A) KBC/S.55291 Org.

Land-sited balloons would cover most of the inner channel of the estuary, which was shallow, narrow and meandering and for these reasons to route shipping so as to avoid mined areas would be impossible; a certain number of waterborne balloons therefore be needed but since no suitable craft were immediately available it was decided as a temporary measure to deploy the whole squadron on land.

Thus, eight balloons were sited alongthe north side of the water between Landguard Point and Felixstowe Point, and the remaining eight on the south side between Harwich Harbour and the anti-aircraft headquarters at Cliff, Dovercourt. Accommodation for half of the Felixstowe crews was found without difficulty but the remainder were put under canvas pending the provision of huts, while on the Harwich side suitable billeting arrangements were made in the neighbourhood of the sites.

ibid. Encl.46A. 5/12/39.

The ideal plan for the siting of the barrage was considered to be eight land-based and eight waterborne balloons, the latter comprising five moored barges and three drifters with a limited patrol. By the beginning of December, however, it was considered that patrolling drifters would not be desirable in the channel during the hours of darkness owing to the number of vessels under weigh in this somewhat confined space. It was therefore decided to make the three drifter balloons static by re-siting them on barges.

/In the

ibid.
Encl.38A.
30/11/39.

In the meantime, the Air Officer Commanding, Balloon Command, was perturbed about the safety of the personnel who would be called upon to serve in the 230-ton barges. These barges appeared unlikely to be sufficiently seaworthy to stand up to open sea conditions, having been built for use in the sheltered reaches of the Thames. Further, they lacked any form of covered accommodation or other amenities. He therefore made it a condition that they should not, in any event, be made operational until they had been made more suitable. The question of the safety of the personnel still remained undecided, and he ruled that :-

> "until it has been demonstrated that their employment is safe the lives of the personnel should not be adventured."

As regards flying balloons from these barges he ordered that operations should conform, so far as possible to the rest of the barrage but that as crews, for the time being at any rate, would leave the barges after completing an operation, a greater degree of casualty risk to the balloons would have to be accepted.

DCOS(AA) 30.
13/1/40
DCOS(AA)
6th Mtg.
16/1/40

With the decision to use Felixstowe as the main Motor Torpedo Boat Base for operations against enemy surface ships, the Deputy Chiefs of Staff (Anti-Aircraft)Sub-Committee considered the adequacy of the existing balloon barrage for protecting this base against attack by low-flying aircraft, and decided on the 16th January, 1940 to re-site certain of the balloons.

DCOS(AA)
46.
3/2/40

A paper prepared a fortnight later, however, discussing the defences of the sister port of Harwich, pointed out that, with a destroyer flotilla and two groups of anti-submarine striking force vessels permanently based there, and with a very large number of minesweepers and auxiliary craft operating from the Parkstone Quay base, quite apart from the considerable expansion of Parkstone Quay itself, increased anti-aircraft defences would logically be required. It was therefore suggested that, among other measures a further flight of eight balloons should be provided to cover the Parkstone Quay area.

DCOS(AA)
7th Mtg.
6/2/40

On the 6th February, the sub-committee authorised this additional protection which, with perhaps the re-siting of certain balloons already flying, was considered adequate.

AHB/ID/34/4/34(A)
~~AHB/S.55398/Ops.~~
29/11/39.

The enlarged squadron consequently disposed twenty-four balloons of which seven were land-based on the Felixstowe side, seven on the Harwich side, and the remaining ten waterborne on barges.

AHB/ID/34/4/34(A)
~~AHB/S.55398/Ops.~~
29/11/39.

The Thames Barrage

On the 26th November, 1939 a conference was held at the Admiralty to discuss the problem of providing balloon defences in the Thames estuary against low-flying minelaying aircraft. It was decided that it was not practicable to site the balloons on land and the barrage, therefore, which was to consist of 50 L.Z. balloons, should be entirely waterborne, sited to defend the Yantlet dredged channel between longitude 0 degrees 43 minutes east and longitude 0 degrees 54 minutes east.

The methods of operating balloons from seagoing craft and barges and the provision of a hydrogen service were discussed, and following the conference, the Senior Air Staff Officer (Headquarters), Balloon Command, and Major V.T. Thomas Royal Marines, visited the Port of London Authority to ascertain what

/vessels were

vessels were obtainable. Contact was established with the Rear Admiral, Port of London Authority (Rear Admiral Boyle) and with other officials from whom it was learned that the anchoring of dumb barges in the Thames estuary was not a practicable proposition during the winter months, and that power barges, of which a number was available, would be more suitable. One of these barges was inspected and approved. Six could be made available within twenty-four hours and further vessels procured to make up the number to fifty. It was decided that the barge crews, each of four civilians, would be retained and that in order to expedite deployment the barges should be delivered to Dagenham Docks where facilities existed to hoist winches and where balloons could be inflated on shore and easily transferred to the barges before they proceeded to their allotted positions in the estuary.

A depot ship was also required, and the pleasure steamer s.s. "GOLDEN EAGLE" and a number of other craft were requisitioned; the Commander-in-Chief, Nore, being requested to make arrangements for moving the ship off Sheerness and for a General Post Office cable to be laid from the shore for communication purposes. Communication between barges and the depot ship would be either by short wave R.T. or Aldis signal lamp. The balloon crews would be divided into two watches, each watch spending twenty-four hours on the barges, before being relieved. A small shore station would be required at Sheerness to receive stores and hydrogen and for minor repairs. Meteorological services would be supplied by No.16 Group at Chatham while a meteorological assistant, Grade II, would be posted to the squadron.

No.953 Sqdn. F.540. Appendix "E" Nov.1939.

Wing Commander G. Aste was appointed to command No.952 Squadron, which was immediately formed within No.30 Group for this purpose, crews and equipment being withdrawn from the London barrage as required. On the 29th November, Wing Commander Aste proceeded to Sheerness and on the following day encountered the first of the many complications that were to arise. Having obtained space in the dockyard for the shore station, he visited the "GOLDEN EAGLE" which had arrived at 10.30 hours and was tied up to No.2 buoy. Here he met the captain who had been detailed by the General Steam Navigation Company to command the ship whilst she was being towed from the Port of London. Having been shown round the ship Wing Commander Aste was requested to sign for its delivery and for all stores and equipment. This he refused to do without authority, and asked the captain to telephone the General Steam Navigation Company. As a result the captain and the first officer decided to return to London leaving behind three engineers and three firemen. It soon became apparent, however, that the crew was not prepared to remain unless some satisfaction was given them regarding their rates of pay. Furthermore, they had no food.

Wing Commander Aste surmounted this problem by promising the crew sufficient rations and undertaking to raise the question of their pay in the appropriate quarter.

Meanwhile, it was clear that the question of feeding the squadron was one which might cause a great deal of difficulty. Wing Commander Aste accordingly visited the Captain, Dockyard, and made arrangements for the Navy to undertake the victualling of all personnel for the time being.

Returning to the "GOLDEN EAGLE" Wing Commander Aste then made a thorough survey of the ship, ascertaining that it would be impossible to accommodate the entire squadron on board. A house at 67, Marine Parade was therefore requisitioned as Squadron Headquarters.

/By the

By the following day some balloons were flying from their barges, but, owing to the late arrival of a tug which had been promised at 12.00 hours and did not arrive, it was not possible to relieve their crews at the time arranged. The only other tug available, the "LION", was being employed carrying out radio telephony tests between barges, from which she returned at 14.00 hours. In view of the fact that the weather was becoming worse and the sea increasingly rough, Wing Commander Aste decided that it would not be possible to relieve the crews but instructed one of his officers, to visit the barges in the tug with sufficient rations both for crews and bargees. This was only accomplished by keeping the bows of the "LION" broadside on to the barges and handing over boxes of food whenever possible. This had been successfully carried out at only three of the barges when the skipper of the "LION" announced that he must return his ship to Sheerness before dark.

During the ensuing days further troubles arose. There were more difficulties with the barges. On one barge, "WILFRED", for example, it was found that rivet holes were leaking badly and the crew together with the airmen were occupied almost continuously at the bilge pump. On another barge - with the romantic name of "HELEN OF TROY" - it was discovered that the air force crew had been without rations for four days and when relieved had only half a loaf of bread between them. Yet another barge - "PIPER II" - was unable to extract water from her fresh water tank.

Nor were the civilian crews of the barges co-operative. No provision appears to have been made with regard to their pay, rationing or release, and all spoke their minds to Wing Commander Aste and in some cases were as unhelpful as possible to the air force crews aboard their craft.

A48/TD/34/4/33
~~T88/85537/Ops.~~
5/12/39.

Because of the increasing operational and administrative difficulties which were arising in implementing the barrage, a further conference was held at the Admiralty on the 5th December 1939 to consider the desirability of modifying the plan of balloon defence. It was stated that conditions in winter east of a line 180 degrees true from Shoeburyness rendered it undesirable, both from the point of view of hardship which would be suffered by crews, and the difficulty of administrative control, to operate balloons from static barge sites, and it was decided that in this area balloons would be flown from twelve drifters which would anchor before sunset each day at points to be decided upon between the Rear Admiral, Port of London, and the Air Officer Commanding, No.30 Group, in collaboration with the Port of London Authority. The area to the west of a line 180 degrees true from Shoeburyness would be defended by balloons flying from twelve barge sites. These sites would be administered from two tugs and two launches with an additional tug and launch held in reserve.

As a result of this conference the Thames barrage was for the time being reduced to twelve balloons on barge sites. Most of the barges, however, had to be returned to Tilbury in exchange for others on which there was proper accommodation for the air force crews and which were fitted with Peto Scott radio telephony sets.

On the 12th December, six drifters arrived at Sheerness from Lowestoft. These were immediately fitted with radio telephony and generally prepared for service.

/Two days

No.952 Sqdn.
F.540
14/12/39.

Two days later, Headquarters, No.30 Group issued an instruction which clarified the position of the air force personnel who were working alongside the crews of the drifters. This stated :-

> "where drifters, barges or other water craft from which balloons are flown, carry marine crews, the captain of the vessel or the senior seaman is responsible for the handling and safety of the vessel and his instructions, even to the extent of cutting the balloon adrift, must be complied with by the balloon crew on board. If time permits when such a situation arises the balloon should, if possible, be hauled in and deflated, or alternatively hauled in before cutting adrift to prevent further damage caused to electric undertakings, etc. by a trailing cable."

By the 18th December, No.30 Group had issued an instruction outlining the flying policy to be followed. Balloons from drifter sites were normally to fly at 2,000 feet. In the event of an air raid warning being given these balloons were to be flown as high as possible. At barge sites balloons were normally flown at 600 feet with discretion to fly to 1,000 feet if considered necessay on account of weather. On an air raid warning being given this was to be increased immediately to 4,500 feet, the maximum operational height.

More drifters continued to arrive at Sheerness and by the 23rd December the squadron was flying its full establishment of twenty-four balloons, and had taken over the Range accommodation building from the Navy as additional accommodation.

The Kyle of Lochalsh Barrage

S.3121.
Encl.1A.

At the 4th meeting of the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee held on the 2nd January, 1940, it was recommended that a barrage of approximately sixteen balloons should be provided for the Kyle of Lochalsh, as part of the defences for a naval operation, due to take place in April. This might result in as many as 2,000 to 3,000 mines being located in the anchorage at any one time.

ibid.
Encl.7A.

A meeting was held, therefore, at the Air Ministry on the 9th January, 1940 to discuss the operational and administrative arrangements for the barrage. The first suggestions were that it should comprise seven mobile waterborne balloons and six land sites, subject to reconnaissance by representatives from the Service Departments, Anti-Aircraft and Balloon Commands. The possibility of the transfer of the mine-laying base to Oban was also raised, but at a further meeting at the Admiralty on the 18th January, it was decided not to proceed at present with a similar reconnaissance at Oban.

DESTROYED
S.59382.
Encl.3A.

The reconnaissance party left for the Kyle of Lochalsh on the 23rd January, where it discovered that there were four possible bases from which the proposed barrage might be conducted - Kyle of Lochalsh, Strome Ferry, Dornie Bridge and Kyleakin. Of these Kyleakin on Skye at the seaward end of the loch was selected despite the disadvantages of bei ng separated from the mainland and of the pier not being approachable by drifters owing to shallow water. To obviate these difficulties, the Admiralty were asked to supply additional ferry facilities between Kyleakin and the mainland and to dredge the loch near Kyleakin quay. The reconnaissance report stated that

/balloon sites

balloon sites would have to be near existing roads, as the ordinary terrain was unsuitable for any form of traffic. On the strong representation of the naval authorities it was recommended that there should be ten waterborne sites and six land sites, four on Skye and two on the mainland; squadron and flight headquarters of the land sites should be on Skye, and headquarters of the waterborne flight on the mainland. (1) The Navy would provide twelve drifters and three other craft for the waterborne flight. Hydrogen would be despatched by rail from Billingham or Runcorn.

ibid. Encl.17B.

Meanwhile, instructions had been given for the formation on the 1st April of No.956 Squadron at No.8 Balloon Centre for deployment to "Port B", as the Kyle had now become known.

ibid. Encl.35A.

However, on the 5th March it was decided that No.921 Squadron should be re-formed for this purpose and consist of one waterborne flight of eleven, and a land-based flight of five, balloons.

ibid. Encl.39A.

A few days later a further change was made and No.935 Squadron, which had been earmarked for service abroad but was now no longer required, was selected by the Air Officer Commanding, Balloon Command, for duty at "Port B".

No sooner had this decision been taken than the squadron was ordered to proceed with Force X, and it was No.920 Squadron which was finally instructed to proceed to "Port B" on the 5th May, the date on which the barrage was required to operate having been put forward to the 15th of that month.

ibid. Encl.47A

In April further discussions took place on the possibility of moving the minelaying base from the Kyle to Oban. The proposal raised many difficulties, for flying boats were now operating from Oban, and it was agreed that, while balloon protection was essential for the minelaying base, it could not operate in conjunction with flying boats. Nevertheless, a reconnaissance party went to Oban to make arrangements for the transfer of the Kyle defences should this become necessary, and sites were noted for eleven waterborne and five land-based balloons, while tentative plans were made for accommodation and communications. Meanwhile, Coastal Command had found it impossible to discover an alternative base for flying boats, and the move to Oban was therefore considered to be impracticable. (2)

ibid. Encl.21A.

ibid. Encl.23A.

No.920 Sqdn. F.540.

No.920 Squadron proceeded from Liverpool to the Kyle of Lochalsh on the 5th May, 1940 being transported by ferry to Skye. As the building of huts had not been completed, airmen were accommodated in tents. Inflations were commenced on the 10th May but orders were received to deflate on the following day. During the remainder of May and the greater part of June airmen were engaged on the preparation of balloon sites, and drifters adapted for flying balloons were arriving. After air raid warnings had been received, instructions were finally given to inflate on the 25th June, but owing to bad weather this was not completed until the 28th June.

/Mobile Balloon

(1) The number of waterborne balloons was later increased to eleven.

(2) In any case, at a conference held at the Admiralty on the 23rd September, 1940, it was announced that the Kyle of Lochalsh barrage was to be transferred to Northern Ireland in October and no more balloons were available.

Mobile Balloon Squadrons - 1939/1941

S.45877
Encl.47A.
28/9/39.

In September, 1939, the Air Officer Commanding, Balloon Command, proposed to the Air Ministry certain measures to provide balloon barrage reinforcements for vital areas which might suddenly become primary enemy objectives. Although the balloon barrage had always been considered tactically mobile it was difficult to effect movements without dislocation of administration. Air Vice-Marshal Boyd proposed to overcome this difficulty by forming new squadrons, withdrawing a certain number of balloons from existing flights for this purpose. At centres first in London and later in Birmingham, a nucleus squadron and flight headquarters staff would be established with the necessary transport and equipment in order that the crews detailed might be organised into flights and squadrons at short notice for deployment in threatened areas. The Air Ministry agreed in principle with the proposals of the Air Officer Commanding, Balloon Command, and suggested that, as the districts for which balloon protection might be required were likely to be industrial areas, mobile units should be built up at the following centres :-

ibid.
Encl.58A.
21/11/39.

London	(for the south-east)
Birmingham	(for south midlands and south-west)
Manchester	(for central midlands)
Tyne	(for northern industrial area)
Glasgow	(for the Scottish industrial area)

The mobile squadrons could be equipped by arranging for the withdrawal of twenty per cent of the balloons from the existing barrages with an addition at each centre of five per cent of the authorised establishment. The adoption of this method would provide a total of 208 balloons for use in mobile squadrons throughout the country.

ibid.
Encl.65A.
30/12/39.

In reply, the Air Officer Commanding, Balloon Command, submitted alternative proposals pointing out that although balloon crews with their equipment could be withdrawn from squadrons they could not be quickly organised into units unless an administrative organisation existed, while a reserve of transport would also have to be held in readiness. He submitted at the same time, plans for the formation of single mobile units.

ibid.
Encl.68A.
7/2/40.

In February, Air Ministry gave instructions for the formation on the 15th February, 1940, of a single mobile balloon squadron at Cardington to consist of four flights of eight balloons each. One complete squadron headquarters and four complete flight headquarters with the necessary administrative staff, transport and equipment would be established at Cardington, but balloon crews would not be provided as they were to be withdrawn from existing barrages when the need for deployment arose. Three flights of "A" Mobile Squadron were to be provided from the London barrage and one flight from Birmingham.

Sig.O.990.
26/4/40.

Sig.O.914.
3/5/40.

Sig.O.923.
3/5/40.

In April, 1940, No.30 Group and No.33 Group were instructed to despatch the crews forming the mobile squadron to their assembly stations; "A" Flight of the mobile squadron was moved from Cardington to Kidbrooke and thence to the Royal Marine Barracks, Deal. In May, "C" Flight went to Southampton for temporary duty with the waterborne flight of No.930 Squadron, and "B" Flight proceeded to Sheerness for waterborne training before going on to Deal for deployment. Later "D" Flight moved to No.15 Balloon Centre, Newcastle.

AHB/IID/34/5/6(B).
~~KBC/S.50491/20/2/Org.~~
6/5/40.

In May, 1940, it was decided to increase the strength of "A" Mobile Squadron to 56 I.E. balloons, and groups were instructed to allocate crews as follows :-

/No.30 Group

No.30 Group	18 crews,	but not from Nos.952 and 958 Sqdns.
No.31 Group	30 crews,	but not from Nos.949 and 918 Sqdns.
No.32 Group	9 crews,	but not from No.953 Sqdn.
No.33 Group	4 crews,	but not from Nos.936, 937, 938, 942 and 948 Sqdns.
No.34 Group	5 crews,	but not from Nos.929, 943, 950 and 920 Sqdns.

Sig.O.793
11/5/40.

~~KBC/S.50491/39/~~
~~Org.~~ X 13/5/40.
ibid.
14/5/40.
Sig.O.507
20/5/40.
~~KBC/S.50491/714~~
~~Org.~~ X 27/5/40.

Sig.O.816
25/6/40.

No.956 Squadron was formed at Deal from "A" Mobile Balloon Squadron, and instructions were given for a mobile squadron to be re-formed at Cardington and brought up to strength again. It was to consist of seven flights of eight balloons each with one of its flights operating temporarily with No.930 Squadron and one at Newcastle. As it was found that a seven flight squadron was too cumbersome it was proposed that the mobile squadron should be re-organised into two squadrons to be called No.957 Squadron consisting of four flights, and No.958 Squadron made up of three flights. The formation of the latter squadron however, was cancelled and its place taken by No.912 Squadron, already established at Cardington with a strength of twenty-four balloons. It was also decided that Nos.912 and 924 Squadrons both then at Cardington, were to retain their overseas establishments and to be considered mobile units.

Sig.O.936
26/6/40.

At the end of June, No.956 Squadron, which had been re-established as a unit of thirty-two balloons, was instructed to proceed to Langley, Buckinghamshire, the twenty-four crews constituting three flights, to which the squadron was reduced for this deployment, which was carried out on the 29th June, being provided by No.30 Group. No.912 Squadron proceeded to Brockworth on the 26th June, and No.924 Squadron to Eastleigh on the 29th June.

Sig.O.352
29/6/40.
Sig.O.670
1/7/40.
Sig.O.121.25/7/40.
Sig.O.988.11/8/40.
Sig.O.122.25/7/40.
~~KBC/S.50491/~~
~~38/Org.~~ X
16/11/40.

To replace these squadrons two further mobile squadrons Nos.957 and 958, were formed at Cardington on the 1st July, 1940; the former proceeding to Yeovil and the latter to Swansea when they ceased to form part of the mobile barrage. No.959 Squadron was formed on the 26th July, 1940, and to Falmouth on the 14th August with a strength of fourteen land and ten waterborne balloons, and became part of No.32 Group.

Sig.O.493
23/11/40.
Sig.O.184
6/12/40.
Sig.A.394
12/2/41.
~~KBC/S.51073/7/~~
Org. 29/6/41.
~~KBC/S.50510/21~~/AHB/ID/34/5/7
~~Org.~~ 18/6/41.

Further squadrons were formed at Cardington as replacements, and the Air Officer Commanding, Balloon Command, in November, 1940, obtained Air Ministry authority to form complete mobile squadrons instead of continuing the policy of withdrawing crews from existing barrages. As a result, Nos.963 and 955 Squadrons were formed at Cardington as complete three flight squadrons, the former proceeding to Accrington in December, and the latter to Weston-super-Mare. Yet two further mobile squadrons were formed, No.931 and No.970, the former proceeding to No.10 Balloon Centre for subsequent deployment as part of the Manchester barrage, and the latter being despatched to Barrow-in-Furness.

S.73006/04
10/7/41.
~~KBC/S50491/~~
~~90/Org.~~ X
13/7/41.

Cardington was once again denuded of mobile squadrons, and the Air Ministry after consultation with the Air Officer Commanding, Balloon Command, decided in July, 1941 that no further units of this type should be formed.

/SECTION 3.

X AHB/ID/34/5/6(B+C).

THE PROTECTION OF VITAL POINTS IN THE AIRCRAFT INDUSTRY

On the 16th September, 1939, the Chief of the Air Staff (Air Chief Marshal Sir Cyril Newall) submitted a note to the Chiefs of Staff on the Protection of Vital Points in the Aircraft Industry.

> "Information at my disposal", he stated, "with regard to the considered views of the German Air Staff as to the most effective method of employment to their air striking force in a war against another air power is to the effect that they regard the destruction or neutralization of the opposing Air Force as the primary aim at the outset. German manuals, and other published writings, make it clear that this policy will be implemented by attacks on the opposing air forces on the ground as well as in the air, and it is logical to conclude that such a course of action will include attacks on the aircraft industry ... Since the enemy must be aware of our present numerical inferiority in aircraft, both as regards first-line and also reserves, it would be in his interest to attempt the immediate destruction of our sources of supply of air material at the outset".

The Chief of the Air Staff went on to draw attention in particular to the Sheffield and Coventry areas which constituted key centres of major importance to the whole of the aircraft industry. The Coventry area contained factories which produced by far the largest proportion of light alloy components, while Sheffield was the largest producer of the steel materials used in aircraft construction. Derby and Bristol were also most vital in connection with aero engine production. If serious damage was inflicted in areas such as these the whole of the aircraft industry, wherever situated, would be virtually paralysed.

The Chief of the Air Staff proposed therefore to issue a general directive to the Air Officer Commanding-in-Chief, Fighter Command, indicating that the aircraft industry was to be regarded as a very probable first objective for enemy air attacks against the United Kingdom, instructing him to re-examine the defence situation on that basis and requesting him to undertake any modifications to the present deployment of the defences which might consequently appear desirable.

D.H.O. Folder "Defence of Aircraft Industry".

The Chiefs of Staff approved the Chief of the Air Staff's proposals and the following day, the Deputy Chief of the Air Staff (Air Vice-Marshal R.E.C. Peirse) wrote to Air Chief Marshal Sir Hugh Dowding setting out these views and listing a number of areas as particularly requiring attention. On the 19th September a signal was despatched to the Air Officer Commanding-in-Chief giving him the Air Staff's order of priority of their vital points.(1) On the 22nd September, the Deputy Chief

ibid.

/of the

ibid. (1) It is interesting to note that the First Lord of the Admiralty (The Rt.Hon.Winston S. Churchill) was also concerned with the safety of aircraft factories. In a letter to the Secretary of State for Air (Sir Kingsley Wood) dated 18th September 1939 he wrote: "I feel increasingly that an air attack on our aircraft factories would be the right thing for the Germans to do before the weather seriously deteriorates; and that this is far more likely than a heavy land offensive in the west. I see there are renewed efforts of German Air Force concentrations towards us. In these circumstances, would it not be as well to take some of the balloons and anti-aircraft guns from London for the defence of the principal aircraft factories at Coventry, Derby, Bristol, etc? I would support this policy if you proposed it".

of the Air Staff again wrote to the Air Officer Commanding-in-Chief stating that, whereas the directive of the Chief of the Air Staff had defined the nerve centre of the aircraft industry in terms of key points, an appreciation prepared by the Air Member for Development and Production (Air Marshal W.R. Freeman) had expressed views in terms of areas. In these circumstances it was necessary to indicate in general terms the areas which could be weakened in order to strengthen the defences of vital aircraft factories.

In the light of existing conditions, the threat of air attack on London as an initial act by the German Air Force had receded. The emphasis was on the air force as such, including the aircraft industry. The Air Officer Commanding-in-Chief was informed therefore that as a general guide he could assume that the central London area together with areas such as Cardiff, Swansea, Leeds, Liverpool and Manchester, (less the Widnes/Runcorn area) which received protection from the general air defence of the country, could be regarded as reservoirs from which limited withdrawal could be made in favour of the following key factories :-

A48/11H/240/4/137
~~F0/8.17531~~
Encl.50.

London area

Hawkers, Ltd.	Kingston-on-Thames
Vickers, Ltd.	Weybridge
Napier, Ltd.	Acton
Handley Page, Ltd.	Cricklewood
Handley Page, Ltd.	Radlett.

Derby area

Rolls Royce, Ltd.

Crewe area

Rolls Royce, Ltd.

Sheffield area

Ambrose Shardlow, Ltd.
English Steel Corporation, Ltd.
Firth Derihon Stampings, Ltd.
Firth Vickers Stainless Steels, Ltd.
Thomas Firth & John Brown, Ltd.
Hadfields, Ltd.

Coventry and Birmingham areas

Armstrong Siddeley Motors, Ltd.,	Parkside
Armstrong Whitworth (Sir W.G.)	Whitley
Daimler Co. Ltd.	
Rootes Securities.	
Standard Motor Co.	
Austin Motor Co.	
Castle Bromwich Aeroplane Factory	
Power Co. Ltd.	
Boulton & Paul (Wolverhampton)	

Southampton area

Supermarine Aviation Co.

Bristol area

Bristol Aeroplane Co. Ltd.
Parnall Aircraft, Ltd.

Gloucester area

Gloster Aircraft Co. (Hucclecote)

/The Crewe

The Crewe Balloon Barrage

ibid.
Encl.13A
15/10/39.
S.2200

Air Chief Marshal Dowding's first move, in so far as the balloon defences were concerned, was to instruct the Air Officer Commanding, Balloon Command, to deploy a barrage of thirty-two balloons to Crewe "as soon as you can conveniently do so".

Encl.1B.
3/10/39.

Air Vice-Marshal Boyd planned to meet this commitment by withdrawing three balloons from each of the London squadrons, thereby raising thirty balloons complete with crews and equipment, and providing the remaining two balloons and crews from No.9 Balloon Centre, Warrington, which he proposed should administer the squadron. On the 13th October, 1939, the Air Ministry

S.2200
Encl.5A.
13/10/39.

signalled their approval of these proposals and No.949 Squadron was formed with effect from that date. The following day, the first flight of eight balloons moved, with full equipment, from London to No.6 Balloon Centre, Birmingham, and proceeded to Crewe on the 16th October, when balloons were inflated and flown. At the same time the remaining three flights, less the two balloons to be provided by No.9 Balloon Centre, were moved from London to Birmingham. The full barrage was flying by the 19th October, on which date squadron headquarters were established at Gresty Lodge, a country house, a mile or so to the south of the town.

Thus, when on the 15th October, Air Chief Marshal Dowding informed the Deputy Chief of the Air Staff of the defensive measures he had taken to protect the vital centres of the aircraft industry he was able to state, inter alia, "at Crewe a new balloon barrage has been created and light defence has been provided".

No further balloon barrages were planned at this stage, Air Chief Marshal Dowding pointing out that Sheffield, Southampton, Birmingham and Coventry already had balloons. At Castle Bromwich, however, the balloons had been adjusted to give cover to the Nuffield Works. The Bristol Engine and Aircraft works could not receive protection from a balloon barrage "because of the flying which must take place from Filton aerodrome".

Further Plans for Balloon Barrages

The question of balloon protection for the aircraft industry now lay dormant until December, 1939, when the General Officer Commanding-in-Chief, Anti-Aircraft Command, informed Air Chief Marshal Dowding that in order to protect the Hawker factory at Kingston with Bofors guns it would be necessary to mount them on specially built towers so that a field of view could be obtained. But even with towers, the Bofors were not likely to be fully effective and the General Officer Commanding-in-Chief suggested that the factory could be better protected if the London Balloon Barrage was extended to cover it. This suggestion was not agreed to, however, because the factory was too far from the limits of the barrage.

ibid.
Encl.37A.
19/1/40.

A similar proposal was raised concerning the Dorman Long Works at Middlesborough, where Headquarters, Anti-Aircraft Command, advocated that certain sections of the works could be protected more effectively by resiting the balloons already

ibid.
Encl.59A.
12/2/40.

deployed in the area. This did not prove entirely practicable, Headquarters, Balloon Command, pointing out that although the twenty-four balloons already deployed could be resited to cover the greater part of the works, to protect the entire works would

ibid.
Encl.69A.
7/3/40.

require some forty-eight balloons. Air Chief Marshal Dowding, however, compromised and instructed Balloon Command to strengthen

/the barrage

the barrage with a further eight balloons, five to be flown on the north side of the River Tees and three to the south.(1)

The Filton Balloon Barrage

ibid. Encl.95A. 27/5/40.

On the 27th May, 1940, Sir Stanley White, Managing Director of the Bristol Aeroplane Co. Ltd., wrote to the Air Officer Commanding-in-Chief, Fighter Command, requesting that a balloon barrage should be provided to protect the company's works. Sir Stanley White was well aware of the difficulties involved by this proposal as a fighter squadron was already operating in the vicinity from Filton aerodrome. He suggested, therefore, that the balloons should be flown immediately the fighter squadron had taken off. On the conclusion of their sortie the aircraft should be detailed to land at Hullavington, or at some other suitable aerodrome in the vicinity, and await instructions to return to Filton when the balloons had been lowered. "At this critical juncture", wrote Sir Stanley, "unusual procedure is fully justified if it increases immunity against air attack, and therefore ensures no interruption in our daily increasing output of both aircraft and engines".

ibid. Encl.97A.

No.935 Sqdn. F.540 2/6/40.

Air Chief Marshal Dowding decided that Sir Stanley White had made out a good case. Two days later he informed him that he would get his balloon barrage in the very near future. He did. A flight of No.956 Squadron, a mobile squadron formed at Cardington, was despatched to reinforce No.935 Squadron at Bristol. This flight set up its headquarters at R.A.F. Station Filton, and completed deployment by the 8th June.

A New Directive

AHB/II H/240/4/137
~~FC/S.17531~~
Encl.100A. 31/5/40.

On the 31st May, 1940, the Air Ministry again wrote to the Air Officer Commanding-in-Chief, instructing him to provide the greatest possible protection to factories (2) engaged on

/the

(1) This plan was approved at the 9th Meeting of the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee on the 1st March, 1940. The new flight of No.938 Squadron was flying by the 14th April, 1940.

(2)

Eastleigh, Southampton Vickers Armstrong,	Langley, Bucks. Hawker.
Woolston, Southampton Vickers Super-Marine.	Kingston, Surrey Hawker
Brooklands, Surrey Hawker Aircraft Vickers Armstwong	Rolls Royce, Derby Rolls Royce, Crewe Rolls Royce, Glasgow
Brockworth, Gloucester Gloster	Filton, Bristol Bristol
Beginton, Coventry Armstrong Whitworth	Ringway, Manchester Fairey
Speke, Liverpool Rootes, Securities Banbury Northern Aluminium	Slough High Duties Alloys

the production of Hurricane, Spitfire and Wellington aircraft. It was suggested that he should not overlook the possibility of extending balloon barrages where possible to cover factories such as Dagington and Ringway, and providing others where desirable. A fortnight later the directive was amplified by the Air Staff who stated :

ibid.
Encl.111A.
15/6/40.

> "In view of the new situation in which it is likely that the entire German bomber and fighter forces will be turned against this country the Chiefs of Staff are uneasy and would welcome a review of the deployment of fighters, A.A. and light A.A. guns, balloons and searchlights in the defence of the aircraft industry, particularly the fighter airframe and engine potential. In carrying out this review you have authority to withdraw to the protection of these vital points such equipment as you consider necessary to provide the required security at the expense of other vulnerable areas in this country. This includes London ....."

ibid.
Encl.113A.
17/6/40.

Two days later, Air Chief Marshal Dowding forwarded his proposals to the Air Ministry. He pointed out that he could not attempt to distribute his limited resources evenly between various factories, but had concentrated on the most important at the expense of those considered not to be main production units. As far as balloons were concerned he proposed to increase the balloon barrages at Sheffield and Derby by twelve balloons each, to establish new barrages at Langley, Brockworth and Eastleigh, (1) each consisting of twenty-four balloons, and to provide one hundred per cent reserves for the barrages at Derby, Crewe, Filton and at Coventry. The balloons that would be required to meet these plans were to be taken from the London, Newcastle and Thames barrages. The 189th Meeting of the Chiefs of Staff Committee held on the 21st June, 1940, approved Air Chief Marshal Dowding's suggestions and it was considered that he had gone as far as was practicable in the defence of the aircraft industry without reducing to a dangerous degree local protection in other parts of the country. However, in July, Air Chief Marshal Dowding decided to deploy twenty-four balloons to Yeovil to augment the defences of the Westland Aircraft works; amd two months later he gave instructions for the despatch of twenty-four balloons to Weybridge, to protect the Vickers works at Brooklands.(2)

ibid. Encl.117A
22/6/40.
2H/99
War Cabinet (40)
Meeting held on
1/7/40.

/The Third

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(1) The proposals were implemented as follows :

> "On the 25th June Balloon Command informed Fighter Command that the barrages at Derby and Sheffield had been increased by twelve balloons each and that arrangements made for No.912 Squadron to proceed to Brockworth on the 26th June; No.956 Squadron was to be deployed at Langley on the 27th or 28th June, and No.924 Squadron at Eastleigh on the 28th or 29th June. These Mobile Squadrons from Cardington arrived at their stations on the dates arranged and balloons were flying at Brockworth and Langley on the 29th June, and at Eastleigh on the 30th June."

AHB/II/H/240/4/137
~~PRO/S.17531~~
Encl.125A
25/6/40.

ibid.
Encl.132A.
136A, 137A.

(2) The Air Officer Commanding Balloon Command met these commitments by moving No.957 Squadron to Yeovil, and No.954 Squadron to Weybridge. The barrages became operational on 26th July and 6th September respectively.

The Third Directive.

S.2741/D.H.O
29/10/40.

By the end of September, 1940, the determined and by no means unsuccessful attacks being made by the German Air Force against aircraft factories led the Air Staff to the conclusion that the deployment of anti-aircraft defences should again be reconsidered. Air Chief Marshal Dowding was instructed accordingly, it being stressed that he was to give special attention to :

The Rolls Royce works at Crewe,
The Bristol Aeroplane works at Filton,
The Boulton and Paul works at Wolverhampton,
The Parnall works at Yate.
Sheffield

AHB/II H/240/4/137
~~FC/S.17531~~
M.190.

A survey was made of the existing defences at Crewe, Filton and Sheffield, but no recommendations were made for any new deployment of balloons at these places.

2H/99.
DHO/3033,
29/9/40.

As shortage of equipment made it impossible to provide adequate protection for all the localities where aircraft were manufactured, the Minister of Aircraft Production now submitted a list of key points concerned with airframe and engine production which he considered should receive the greatest possible protection. The need for action in this respect was emphasized when, on the 3rd October, a single enemy aircraft bombed and damaged the De Havilland Works at Hatfield.

2H/99.
DHO.3080.
3/10/40.

FC/S.17531
Encl.201A.

Three days later Lord Beaverbrook informed the Secretary of State for Air that "De Havillands at Hatfield... are asking for a balloon barrage. If they want it they should have it. We seek in particular, however, protection for :

Hawkers	-	Kingston, Langley and Brooklands
Gloster	-	Brockworth.
Rolls Royce	-	Derby, Crewe and Glasgow.
Castle Bromwich		
Chester (Vickers).		

..... Bristols are working again and I urge their protection upon you".

Sir Archibald Sinclair promptly sent Lord Beaverbrook's letter to Air Chief Marshal Dowding who, in reply, stated he had sent Balloon Command officers to Hawkers at Kingston and De Havillands at Hatfield, but both firms had decided that they would rather do without balloons. In a further letter to the Secretary of State for Air, Air Chief Marshal Dowding went on to point out that Langley and Brockworth already had twenty-four balloons each. "I do not know on what grounds these are considered to be insufficient", he wrote", but I am always open to conviction."

No more balloons, therefore, were to be allocated by the Air Officer Commanding-in-Chief for the defence of aircraft factories. However, early in November the Chiefs of Staff (Anti-Aircraft) Shadow Committee decided that the defence of Coventry (1) should be strengthened and recommended, among other things, that the barrage should be increased to seventy-two balloons. A reconnaissance for this purpose was carried out

2H/99
DHO.3456
4/11/40.

/and four

(1) The Coventry Balloon Barrage had already been strengthened in May, 1940, by the addition of eight balloons to cover Daimlers, and the Standard Motor Co. - See p.p.

and four sites had been occupied when, on 14th November, the German Air Force carried out a most concentrated and, from their point of view, highly successful attack on the city.(1)

2H/99.
M.A.P.letter dated 20/11/40.

No one was more alarmed at the result of this attack than Lord Beaverbrook. On the 20th November, he informed the Secretary of State for Air :

> "The aircraft industry has suffered so severely, and widespread damage has been done to our plants, and our properties, our production has been disturbed so seriously, that we hope very much the Air Ministry will do everything possible to defend Sheffield and Birmingham. Should these two centres fall victims to attack like the recent bombing of Coventry, then our production would inevitably be damaged to an irreparable degree."

However, the Air Staff did not consider anything further could be done to strengthen the balloon defences of these cities and other defensive measures were taken.

2H/99.
D.F. Ops.4665 18/2/41.

On the 27th January, 1941, a JU.88 attacked the works of the British Manufacturing Research Company at Grantham. Lord Beaverbrook immediately requested balloon protection for the works. The Chief of the Air Staff (Air Chief Marshal Sir Charles Portal) explained that a balloon barrage could not be provided owing to the close proximity of several operational aerodromes. Lord Beaverbrook did not accept this and pressed the Chief of the Air Staff to reconsider his decision.

This prompted Sir Charles Portal to explain the limitations of balloon protection:

> "Useful as these barrages are", he wrote, "in practice, they have proved almost as successful in bringing down our own aircraft as enemy aircraft. The operational limitations which they impose have had to be accepted in a number of cases such as Langley and at Filton, but there are I am afraid other places where the operational requirements have to be overriding. Grantham is a case in point. It is situated in an area where there are many aerodromes at which our night bomber squadrons are located and there is also a night fighter squadron stationed at Wittering close by. The risks which these aircraft have to undergo are so great that I do not feel I would be justified in asking them to accept this additional one.
>
> In any case we do not think that a balloon barrage would provide a high degree of protection to Grantham for it would be unable to prevent the normal form of night bombing attack. The best form of protection is anti-aircraft guns, coupled with dispersal and camouflage."

The subject insofar as balloons were concerned was closed.

Accrington and Weston-super-Mare Balloon Barrages.

D.C.O.S.(A.A.) 22nd Meeting 18/10/40.

As a result of a general review of the air potential and because of pressure from the Ministry of Aircraft Production the Sub-Committee of the Deputy Chiefs of Staff (Anti-Aircraft) at their 22nd Meeting held on the 18th October, 1940, decided to invite the Air Officer Commanding-in-Chief, Fighter Command, to consider the provision of balloons for the protection of the new Bristol Aeroplane works at Accrington and Weston-super-Mare.

/On the

(1) See page 356.

C.S. 8049 Encl.2A.

On the 24th November, the Air Officer Commanding-in-Chief informed the Air Ministry that "it has not yet been possible to meet these requirements owing to the shortage of equipment", and he requested that an order of priority in which these, and other requirements that were arising should be discussed by the Sub-committee.

A4B/11D/34/4/7 ~~KBO/S.5068~~ Ops. Encl.11A.

The committee had, however, met two days previously and had decided that the aircraft factory at Accrington should have first priority and the provision of a balloon barrange should be proceeded with as quickly as possible. To meet this requirement, the Air Officer Commanding, Balloon Command, selected a mobile squadron, No.963 Squadron, which had formed at Cardington. The squadron was moved to No.10 Balloon Centre, Manchester, and on the 26th December, authority sought to fly twenty-four balloons at Accrington with effect from the 15th January, 1941. Except for a number of protests from the towns-people, who felt that the advent of balloons meant also the advent of bombing, the barrage was deployed and flown on that date without incident.

The barrange at Weston-super-Mare presented a more formidable problem. On the 6th December, 1940, Headquarters, Fighter Command, informed the Air Ministry that a survey had been made by Balloon Command of the proposed barrage and that a complication had arisen in that there was an Elementary Flying Training School which would be completely surrounded by balloons. The question that now arose was whether the balloon defence was more important than the Elementary Flying Training School.

C.S. 8049 Encl.8A.

The Deputy Director of Home Operations (Group Captain J. Whitworth Jones) therefore placed the problem before the Deputy Chief of the Air Staff (Air Vice-Marshal A.T. Harris).

> "We fully appreciate A.M.T.'s(1) difficulties..."wrote Group Captain Whitworth Jones, "... it has been recently pointed out that the structure and equipment of one of these factories costs about as much as a modern battleship and takes just as long to construct. When in production these factories contain many more men than a battleship and carry much more valuable material. If the Weston-super-Mare factory is destroyed it will have a profound and lasting effect on our war effort. A reduction of pilot output is undoubtedly a serious matter, but if this results from a hasty move not perhaps timed to suit the complex training period, we are only faced with a known, calculable and transitory setback."

ibid. Encl.9A.

The argument was a good one and it convinced Air Vice-Marshal Harris and on the following day, acting on behalf of the Vice Chief of the Air Staff, he appealed to the Air Member for Supply and Organization "for every effort to be made to move No.10 E.F.T.S. by the end of February or early in March at the latest." But when late in April the barrage was ready to become operational the Elementary Flying Training School was still in occupation of the aerodrome at Weston. Therefore the Air Ministry instructed Headquarters, Fighter Command, that it was to be deployed but no balloons were to be flown in daylight except at such times as flying had stopped

ibid. Encl.25A.

/at the

(1) The Air Member for Training.

at the Elementary Flying Training School. When these occasions arose, the balloons were to be flown by arrangement between the barrage commander and the chief flying instructor, but were to be close hauled immediately flying commenced again.

AHB/IID/34/4/6
~~S.50683~~
Encl.50A.

Thus, No.955 Squadron of twenty-four balloons deployed to Weston-super-Mare and became operational with effect from dusk on the 3rd May.

But it was operational for only very brief periods in each twenty-four hours. During the hours of daylight it was controlled by the Elementary Flying Training School and by night became subject, to a control under which it was grounded, together with a number of other barrages, from half an hour after the prescribed blackout time until the cessation of the blackout period.(1) The balloons were released from this latter control only if enemy aircraft were plotted as approaching the barrage area or on receipt of a Red warning from the Home Office.

AHB/IID/34/4/6
~~KRG/S.50683/Ops.~~
Encl.60A.

On 3rd August, 1941, the Air Officer Commanding, Balloon Command, (Air Marshal Sir Leslie Gossage) pointed out these facts to the Air Officer Commanding-in-Chief, Fighter Command, (Air Marshal Sir Sholto Douglas) adding:

> "In practice the E.F.T.S. control is operational with very few exceptions over the whole period stated; while since the night control for the benefit of friendly aircraft has been in operation, neither plots nor Home Officer Red warnings have been received. Consequently it will be seen that the balloons in this barrage remain on the ground for a very considerable portion of the 24 hours".

As a result, continued Sir Leslie Gossage,

> "A severe strain is placed on the keenness of both officers and airmen in the squadron so long as this very restricted period of flying continues."

He suggested, therefore, that if the flying school was likely to continue to operate for an indefinite period, consideration be given to the temporary withdrawal of the personnel and equipment for use in reinforcing other barrages.

ibid.
Encl.63A.

Sir Sholto Douglas in reply stated that the Elementary Flying Training School was likely to be moved on or about the 20th September and in consequence he did not consider it worth while to move the balloon personnel or equipment elsewhere.

Extension of Barrages to Cover additional Vital Points

S.4275
Encl.3A
22/3/40.

At the 10th Meeting of the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee held on the 15th March, 1940, the anti-aircraft defences of a number of additional vital factories were considered and it was recommended that they should be protected by extension of balloon barrages. The list, which had been prepared by the Key Points Intelligence Branch of the Ministry of Home Security, included factories in Coventry, Birmingham, Middlesbrough and Glasgow, and the Director of Home Operations instructed the Air Officer Commanding-in-Chief, Fighter Command, to arrange for a reconnaissance of them and to

/forward his

(1) Fighter Command Operational Instruction No.83.

ibid. Encl.5A.

forward his recommendations, together with an estimate of the number of balloons required, for consideration by the Sub-Committee. The reconnaissance was carried out by Headquarters, Balloon Command, and the following recommendations made:-

Barrage	Vital Factory	Number of Additional Balloons Required.
Coventry	Rootes Securities	Nil (one balloon to be resited)
	Daimlers Standard Motor Co.	8
Birmingham	Booth Janes	8
	Rover	8
Middlesbrough	Cargo Fleet Iron Co.	8
	South Durham Steel Co.	8
Glasgow	Rolls Royce	8
	Steel Company of Scotland (Hallside) Colvilles	12
	Steel Company of Scotland, (Blockairn)	4
		64

These additional flights were in all cases to link up with existing barrages, and in the case of the Middlesbrough barrage to assist in covering the Dorman Long works, for which additional balloon protection had already been authorized. It was not considered possible to extend the Glasgow barrage to cover:-

William Baird, Kilsyth, Stirling.
William Baird, Coatbridge, Lanark.
and Colvilles, Moss End, Lanark.

as detached flights would be required and it was against the general policy to protect vulnerable points by isolated balloon units. These recommendations received the approval of the Deputy Chiefs of Staff Committee at its 12th meeting held on the 17th April, 1940, and the Air Ministry instructed the Air Officer Commanding, Balloon Command, to put them into effect.(1)

ibid. Encl.22A. A.M.Signal O.168 1/5/40.

/Section 4.

(1) This was accomplished as follows:-

Nos.947,946, 945 Sqdns. F.540 20/5/40.

On the 20th May, a complete reorganization of the Glasgow squadrons took place and balloons were deflated and transferred to new sites to cover the vulnerable points.

Nos.913 and 914 Sqdns. F.540 and Y return.

At Birmingham the occupation of new sites was completed on 21st May. At Coventry arrangements were made for the addition of another flight, and the extra balloons were flying on the 6th June.

No.938 Sqdn. F.540 and Y Return 20/5/40.

On the 16th May, No.938 Squadron at Middlesbrough was reorganized as a six-flight squadron and the increased number of balloons was flying by the 20th May.

SECTION 4

THE BALLOON BARRAGES AT HAVRE AND BOULOGNE

S.1918. Encl.1A. On the 13th September, 1939, the Army Council informed the Air Council that they had considered the possibilities of using balloons to assist in the defence of bases and installation used by the British Expeditionary Force, and were of the opinion that they would be of great value for this purpose. While the Army Council fully appreciated that it was not possible for balloons to be provided immediately, they wished to know whether the Air Council would be in a position to supply them at a later date.

ibid. Encl.2A. This request was received with no enthusiasm by the Air Ministry for the resources of Balloon Command were already stretched to their limit. The Army Council was therefore referred to a conference which had been held at the Air Ministry in June, 1939, when the question of the protection of the Field Force by balloon barrages had been examined. The conference (at which the War Office had been represented by Brigadier K.M. Loch) had considered the suggestion that balloon barrage defences might be valuable in the case of objectives such as the base ports, important railheads, and possibly parks or establishments of vital importance which constituted valuable targets for low-level air attacks. It was felt, however, that balloons would be of doubtful value for the defence of ports remote from enemy air bases. They would be difficult to maintain and were incapable of giving protection against low-flying attacks from the sea. Moreover, at other targets such as railheads, parks and establishments, they might well serve as target indicators and, in any case, would constitute a source of danger to our own aircraft, while the maintenance of the hydrogen supply would present a formidable problem. For these reasons, the conference had come to the conclusion that balloon barrage defences for the Field Force would be undesirable.

ibid. Encl.10A. The War Office, however, brushed these considerations aside. On the 6th November, they again wrote to the Air Ministry stating that the Army Council had now decided to develop Havre as a main base port and a considerable number of anti-aircraft guns were being allocated to its defence. With a view to economy in light anti-aircraft artillery resources they requested that the provision of balloons at the port might now be considered by the Air Council. At the same time they intimated that balloons might also be required at Boulogne.

ibid. Encl.12A. Fifteen days later, their intimation was supplemented by a definite request. The Army Council had decided that Boulogne should be used as the port for the shipment of leave personnel, and would require a high degree of protection from air attack. They were of the opinion that the employment of anti-aircraft guns alone for this purpose, and in particular to meet low-flying attack, would impose a very great strain on the already inadequate resources of the British Expeditionary Force and would involve a most undesirable withdrawal of light anti-aircraft guns from the forward areas. The Army Council therefore requested that a sufficient number of balloons to afford protection to the vulnerable area of the port should be provided as soon as possible after the 15th December - the date on which it was intended to put the port into use.

/The Air

ibid.
Encl.17A.

The Air Staff did not accept this new commitment without a fight. Whilst agreeing that Havre should have a barrage of twenty-four balloons, they stated that so far as Boulogne was concerned they considered that owing to the geographical position of the port, a balloon barrage would possess the serious disadvantage of drawing attention to the vital areas and would be difficult and costly to maintain in the face of persistent air attack from the sea. Also, it would not be possible to establish the barrage by the date required, unless the Army Council were prepared to agree to the withdrawal of balloons from other vital points. Otherwise, the barrages could not be provided before March, 1940, at the earliest.

ibid.
Encl.18A.

The War Office rejoined that the use of Boulogne by the British Expeditionary Force could hardly escape the notice of the Germans and the Army Council were therefore prepared to accept the risk of attention being drawn to the point by the presence of balloons. Because of the resultant saving in light anti-aircraft guns they also accepted the possible loss of balloons by attack from the sea. They, therefore, renewed their demand for the provision of balloons at both ports, priority being given to Havre. The Air Ministry yielded.

ibid.
Encl.22A.
DESTROYED
S.59381
Encl.2A.

On the 31st December, 1939, they informed the War Officer that they would accept the two new commitments, but that balloons would not be deployed and ready to fly until March, 1940. The Air Ministry therefore informed the Air Officer Commanding, Balloon Command, on the 8th January, 1940, following previous verbal notification, that it had been decided to form No.1 (Balloon Barrage) Wing for service in France by the 1st March. The wing would be placed under the command of the Royal Air Force Component of the British Expeditionary Force except for technical administration which would remain the responsibility of Balloon Command. Meanwhile, reconnaissance should be made of Havre and Boulogne to determine the siting of balloons and to make the necessary administrative arrangements, and also to investigate the possibilities of obtaining hydrogen from French sources.

ibid.
Encl.12A.

Instructions were given for the formation of No.1 (Balloon Barrage) Wing at No.5 Balloon Centre (Birmingham North) on the 22nd January. The wing was to consist of two squadrons, No.912 Squadron and No.924 Squadron, and the first intention was that they should be of equal strength. It was later decided, however, that No.924 Squadron should consist of three flights of eight balloons each and undertake the

ibid.
Encl.15A.

protection of Havre, and No.912 Squadron, consisting of two flights of eight balloons each, should be based on Boulogne.

ibid.
Encl.17A.

Two staff officers of Headquarters, Balloon Command (Group Captain G. Cock and Wing Commander C.J.R. Turner) proceeded to Havre and Boulogne to make the preliminary reconnaissance. The main objectives to be defended at Havre were the port, docks, quays and petrol storage stations, while at Boulogne similar objectives existed with the addition of

ibid.
Encl.18A.

the Gare Maritime. The reconnaissance party made contact with the brigadier commanding the base sub-area at Le Havre and with Admiral de Villaine, the commander of the port and the land defences at Havre, who asked to be given operational control of the barrage in order that aircraft could operate when required. Despite some difficulties twenty-four sites were located for the protection of Havre and their positions co-ordinated with anti-aircraft sites. Suitable accommodation was found for three flight headquarters and a squadron headquarters.

/The

The reconnaissance party next proceeded to Boulogne, made similar contacts and located twelve sites. In view of the fact that the local French naval commander at each port exercised operational control over British anti-aircraft guns, it was agreed that operational control over the barrages should also be vested in these officers. A meteorological officer was to be attached to each barrage and the army agreed to instal telephone communications. The reconnaissance party decided that the wing headquarters should be at Havre, adjacent to the squadron headquarters.

4342/Org.1
Encl.10A.

While the French Admiralty, which was responsible for the defence of the coastal areas to be covered by the balloon barrage, accepted very willingly the protection offered, it asked that the allocation of this form of defence should be submitted to the Admiral Commandant-en-Chef les Forces Maritimes du Nord at Dunkirk for his approval and that the disposition of the balloon detachments should be under the control of the local French naval commander. These stipulations received the approval of the Air Ministry and the concurrence of the General Officer Commanding-in-Chief, British Expeditionary Force (General Viscount Gort)

ibid.
Encl.18A.
ibid.
Encl.25A.

DESTROYED.
SB.~~2810~~

Investigation had continued into the possibility of obtaining hydrogen for the Wing from French sources. A hydrogen factory at St. Etienne, some 375 miles from Boulogne, had been allotted to the Royal Air Force. This factory had an output of 500 cubic metres a day which it was hoped shortly to increase substantially, and the suggestion was made that a hydrogen plant might be set up in the Havre or Boulogne districts to supply the barrages. While it might be possible to obtain ultimately sufficient hydrogen from the St. Etienne source, it was considered that the difficulties over transport, either by road or rail, and over the supply of cylinders, made it impossible to rely on it as a sole source of supply, and that hydrogen for initial inflation and maintenance would have to come from England. It was thought that a weekly sailing each way with fifteen to twenty trailers would suffice, and it was recommended that the possibility of using St. Etienne as an emergency of subsidiary source of supply should be investigated. In view of these recommendations the Director of Equipment decided that hydrogen for the Wing should be provided from England and the St. Etienne supply considered as an emergency source. An allocation of 1,950 cylinders was made for the hydrogen supply of the barrage, and, while the provision of a local plant in the Havre or Boulogne district remained under consideration, it was pointed out by the Director of Equipment that such a source would only suffice for a small proportion of the requirements of the barrage, and in any case would not affect immediate plans.

ibid.
Encl.13B.
ibid.
Encl.16A.
ibid.
Encl.18A.
ibid.
Encl.19A.
ibid.
Encl.26A.

Headquarters, Balloon Command, asked for arrangements to be made for the shipment of hydrogen from Southampton - where suitable facilities existed - to Havre commencing on the 1st March, and for the St.Etienne supply to be retained for emergency use. On arrival, the wing commander would consult the French authorities regarding further sources of hydrogen and the whole matter was to be reviewed when experience had been gained.

ibid.
Encl.36A.

A.M. File
S.3138
Encl.29A.

On the 31st January, Headquarters, Balloon Command, were informed by the Director of Organisation that the War Office had made provisional arrangements for the shipment of the wing to France. These arrangements specified that the Boulogne unit should be shipped complete from Dover to Dunkirk by ferry on the 13th February; the motor transport of the

/Havre

Havre unit was to sail from Southampton on the 19th February and the personnel on the 19th February or 22nd February.

ibid. Encl.45A.

On account of the distance from a source of technical supplies, each squadron was equipped with technical equipment considered sufficient for one month. Future demands for all classes of equipment were to be made on No.25 Maintenance Unit, Hartlebury, and such technical equipment as would not in normal circumstances be stocked there was to be transferred from Cardington to supply the needs of the wing.

Shipment to France was completed by the 19th February and on that date No.1 (Balloon Barrage) Wing and No.912 and No.924 Squadrons were transferred from Balloon Command to the Royal Air Force Component of the British Expeditionary Force.

Conditions at Havre and Boulogne. (1)

S.4342/Org.1 Encl.29B Appendix A.

The situation at Havre at the time of the move from England is described in a report submitted to Headquarters, Balloon Command, on the 15th February, 1940, by Wing Commander K.P. Angus, the officer commanding No.1 (Balloon Barrage) Wing. Many difficulties had been encountered in securing suitable premises and it had been found impracticable to accommodate both wing and squadron headquarters in the building selected, which was to be vacated by No.3 Base Headquarters. Accommodation had been found for two flight headquarters, sites selected for huts for the third and a building taken over for balloon inflations. The positions of some of the sites first chosen had been altered and many required concrete blocks before balloons could be flown. There had been serious delay in delivering the materials for huts. Telephones had not yet been installed.

ibid. Appendix A.

A second report dated the 6th March stated that it had been impossible to keep to the dates proposed for the operation. At the earnest request of Admiral de Villaine, one balloon had been flown at Havre on the 25th February, but unfortunately it was lost a few days later. One of the reasons advanced for the slow progress was that site preparation was far from complete and most of the constructional work that had been accomplished on sites both at Havre and Boulogne had been carried out by airmen. At Havre no huts had yet been erected as the contractors had refused to work without plans which had only just arrived, while at Boulogne a few huts had been built without plans.

ibid. Encl.20A.

With the approval of Headquarters, Air Component, Wing Headquarters had been established at Amiens where a more central control over the barrages could be exercised. The Royal Engineers had begun to instal telephones for both barrages. There were serious deficiencies in the supply of equipment which squadron equipment officers were unable to remedy owing to lack of information regarding the approved initial scale and that which had actually been despatched from England.

/Arising out

(1) The Operations Records Books (Forms 540) and other official records of No.912 and No.924 Squadrons were destroyed before the evacuation of Havre and Boulogne and it has not been possible to give a full account of the activities of these squadrons. Such reports and incomplete records that survive have been utilised to describe the conditions first encountered in France and the circumstances of evacuation.

ibid.
Encl.29B.
Appendix D.

Arising out of these many difficulties which had complicated the deployment of the squadrons, various recommendations for future guidance were made by those who had experienced the problems. It was considered that the commanding officer and the engineer officer should invariably be included in an advance party, the former to supervise the selection of headquarters, and the latter to assess the work required for the preparation of balloon sites. More information should be given to squadron equipment officers, and demands for equipment should be submitted direct by squadron and not centre equipment officers while the material for huts, together with plans for their erection, should be despatched in time for the work to be finished before the arrival of the main party.

No.912 Squadron, Boulogne

DESTROYED.
S.62471
Encl.1B.

The main party of the Boulogne squadron arrived so soon after the advance party that practically no arrangements could be made for its reception, though the advance party had worked hard to provide accommodation. Indeed, living conditions continued to be difficult throughout the deployment as accommodation had not been completed even by the time the squadron was obliged to leave the port. No field service beds were ever supplied and many men were, for some time, without paliasses. Cleaning materials could not be obtained nor were flight headquarters supplied with any office furniture or means of keeping documents in safety.

Operational problems included difficulties over the hydrogen supply which came from Calais and was often interrupted. The Boulogne area endured frequent air attack, as many as sixteen air raid warnings being sounded in the course of a single day. But, except for the last two days, when conditions were chaotic, the barrage, always maintained at its full strength of sixteen balloons, appeared to fulfil its purpose, for while it was in operation the enemy did not inflict damage on the objectives it was protecting and no dive bombing was attempted in the actual barrage area. However, many balloon casualties were caused by the porosity of the balloon fabric, proofing being poor and patches and seams peeling in warm weather. This point, advanced by the balloon officer in an appendix to the report on the operations of No.912 Squadron, is supported by a similar report by one of the flight commanders who asserted that, after balloons had been flown for about a month their purities began to fall to the extent of 1% per day.

No.1 (Balloon Barrage) Wing, May, 1940.

F.540

At the beginning of May, Wing headquarters were established at Amiens. With his Squadron Leader (Administration), Wing Commander Angus attended a conference on the 1st May, at General Headquarters, Arras, to discuss the future balloon policy.

As there was a possibility of General Headquarters moving to Doullens, arrangements were to be made for a reconnaissance there with the object of finding balloon sites. This was carried out later in the month, but no balloons were ever flown at Doullens.

At this time a large number of deflations in both barrages was occurring through loss of purity, and as investigation revealed that a contributory cause was the age of the balloons which had been supplied, the Air Ministry were

/requested to

requested to provide twenty-five new balloons. On the 17th May, while at Havre, Wing Commander Angus informed the Air Ministry of the shortage of both balloons and hydrogen which had arisen because of the many deflations through loss of purity and was advised that more balloons were on the way and that it was intended to despatch, in future, two trailers of hydrogen a day either by way of Boulogne or Calais.

On returning to Amiens, the wing commander issued instructions to No. 912 Squadron for their action should the occupation of Boulogne by the enemy appear imminent. By this time Amiens was being frequently attacked by enemy aircraft and after consultation with Headquarters, Royal Air Force Component, it was accordingly decided to move wing headquarters to Havre. This move was effected on the 19th May. Extensive air attacks were also occurring at Havre but some trailers of hydrogen were brought in from Boulogne and arrangements made by using all available transport to collect a further thirteen trailers from Cherbourg. It was while this convoy was away that a code message instructing No.924 Squadron to withdraw to Dunkirk was received and the events occurred which are described later in a report to the Secretary of State for Air by the squadron commander.(1)

The garrison commander at Havre ordered wing headquarters, and No.924 Squadron to evacuate Havre and proceed to Bernay. Instructions were given to leave the balloons flying from central anchorages and to destroy all secret or useful material that could not be withdrawn. Destructive action was later suspended and after further consultation with the garrison commander it was decided to maintain the barrage for the time being and only to evacuate such personnel as could be spared. Wing Headquarters left Havre on the 21st May, for Bernay, but was delayed at the ferry at Quillebeuf until the following morning. After unsuccessful attempts had been made to make contact at St. Thurion with the units which were known to have crossed the ferry, Wing Commander Angus went on to Bernay where the remainder of the wing detachment had assembled. After reviewing the situation he decided to advise the officer commanding, No.924 Squadron at Havre that owing to the congestion at Bernay any parties evacuated from Havre should go to Lissieux, and that if sufficient equipment was available, personnel who had been evacuated should be sent on to Cherbourg to fly balloons there, but that if equipment was not available those evacuated should go to Nantes. The wing detachment went on from Bernay to Nantes where Wing Commander Angus was informed by Group Captain Carr, commanding No.2 Base Area, that the Royal Air Force Component was returning to England. It was pointed out to Group Captain Carr that the present intention was to fly balloons at Cherbourg if equipment was available. When communication was established with No.924 Squadron it was found that the squadron commander had already recalled all personnel who had been evacuated and the instructions sent by the wing commander had not been carried out. On the 25th June, Wing Commander Angus and his Squadron Leader (Administration) returned to Havre and made unsuccessful attempts to get into touch with the Air Ministry regarding the future of the wing. Group Captain Carr telephoned instructions from Nantes for the wing to return to England, but Wing Commander Angus remained in Havre for a few days in order to find a suitable emergency headquarters and store for No.924 Squadron on the south bank of the Seine. After arranging suitable accommodation at Beuseville, he returned to Nantes and left for England on the 31st May, having handed over all wing transport to No.2 Base.

/No.1

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(1) See pp. 243-245.

No.1 (Balloon Barrage) Wing was disbanded on the 24th June.

No.912 Squadron - Evacuation from Boulogne

A.M.file S.62471 DESTROYED Encl.1B. and F.540.

On the 10th May, 1940, Germany invaded Holland and Belgium and enemy bombers were continuously in the vicinity of Boulogne, an air raid warning being in operation for the whole day. On the following day, when similar conditions prevailed, ammunition was issued to each site, one of which was machine-gunned from the air.

On the 17th May the squadron was ordered to be ready to move from the area at two hours' notice. Air raids increased in intensity; on the 19th May, enemy air action continued all day and night, while mines were dropped in the harbour and parachutists reported outside the town. Next day the town was again heavily bombed from above barrage height, houses being demolished on each side of squadron headquarters, but no main objectives within the barrage area were hit. Sites were bombed and machine-gunned on the 21st May. When evacuation was finally decided upon, operations records books ciphers and code publications were burnt; while on sites serviceable balloons were destroyed except for a few left flying from central anchorages to act as a deterrent to enemy raiders.

Communication with wing headquarters had been broken since the 19th May, and the squadron was instructed to conform with the general defence of the port so long as equipment lasted. When this was no longer possible and the enemy was within two miles of the town, the squadron commander gave instructions for the evacuation plans to be carried out. The squadron with eighteen winches and other motor transport proceeded towards Calais, halting for the night on the roadside under cover of trees. Early next morning it moved to the north side of the town and reconnoitring parties were sent out to make contact with the authorities there, and to find out the conditions prevailing on the roads. In accordance with instructions obtained, transport was driven to the docks and handed over to the Camp Commandant of Calais. The squadron marched to the quay and boarded the "CITY OF CHRISTCHURCH" arriving at Southampton at 14.30 hours on the 24th May and proceeded from there to Cardington where, after re-equipment, the squadron was retained as a mobile unit.

No.924 Squadron, Havre - 19th/23rd May, 1940.

DESTROYED S.59381 Encl.61A.

Events and operations which occurred at Havre between the 19th and 23rd May are described in a report to the Secretary of State for Air by the officer commanding, No.924 Squadron (Squadron Leader W.T. Barnes). On the 19th May, the officer commanding, No.1 (Balloon Barrage) Wing, set up his headquarters at Havre, having been compelled to leave Amiens because of enemy action. Two days later a coded signal was received which gave orders for No.924 Squadron to move to Dunkirk and fly balloons there. This signal, which appeared to have come from Headquarters, Royal Air Force Component, was the subject of suspicion as being of enemy origin.

/After

After discussion with Wing Commander Angus, Squadron Leader Barnes attempted to get in touch with Headquarters, Royal Air Force Component to obtain verification and to point out that it was impossible for the squadron to operate outside its present location, owing to shortage not only of hydrogen but also of transport, as at that time six prime-movers were away on convoy. He was not able to make contact, however, and Wing Commander Angus, stating that he was acting on instructions from Headquarters, Havre Garrison, some hours later ordered the evacuation of the port.

These instructions were received with such dismay by the officers of the squadron that Squadron Leader Barnes visited Admiral de Villaine "the commanding officer of all air defences in this port and from whom I receive all operational orders". The Admiral received the news "with surprise and disgust". In view of this attitude the Squadron commander decided to maintain the barrage as long as hydrogen, now reduced to a three days supply, lasted, and only to evacuate such personnel as were unnecessary for the operation of balloons. A convoy had already been despatched to Cherbourg to collect hydrogen and balloons diverted there because of air raids. Wing headquarters left Havre for Bernay on the 21st May. On the following day Squadron Leader Barnes learned that Havre was to be evacuated, but after a conference with Admiral de Villaine a request, made to the Rouen Sub-Base Area for the cancellation of this order, was accepted. Later in the day, orders were received from wing headquarters that the squadron was to evacuate to Nantes, but Squadron Leader Barnes refused to accept this order.(1) In the evening he received information that the hydrogen convoy was close to Havre and he immediately recalled all personnel already evacuated. By the next morning six trailers and twelve spare balloons had arrived and it was expected that further supplies of hydrogen would shortly become available for the maintenance of the barrage.

No.924 Squadron - Beuzeville Detachment.

Form 540

On the 30th May, No.924 Squadron took over buildings and established a detachment of the squadron near Beuzeville, some fifteen miles south of Havre on the other side of the Seine. It was intended that the camp should be used for stores and for the accommodation of such personnel as could be moved from Havre. Stores were withdrawn from Havre and telephones installed. The squadron commander gave orders that if communications with Havre failed the destination of the detachment at Beuzeville should be Nantes, where it would take orders from the officer commanding, Base Area Port Audemar.

Communications with Havre ceased on the 9th June, and in accordance with instructions received from the Base Area commander preparations were made to move from Beuzeville. During the day hydrogen trailers were converted into vehicles suitable for carrying equipment and balloons. Such equipment as could not be moved was destroyed with the exception of anti-gas clothing and a certain amount of petrol and food which was left behind for use by other troops.

/A convoy

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(1) "I replied that we could not accept this order, and that, on the contrary, I was on the point of recalling the personnel that I had already evacuated. The language used was not justified in accordance with regulations, but the situation justified, in my submission, the measures I took and the forcibility of my language".

- Extract from No.924/8/Air dated 23rd May, from Squadron Leader W.T. Barnes to the Secretary of State for Air.

A convoy was assembled and travelled through the night towards Caen. Allencour was reached by noon next day and the convoy camped for the night on the roadside seven miles from Chateau Fotteau. Next morning the officer in command went ahead to Nantes, reporting to Group Captain Carr, commanding No.2 Base Area, who instructed him to prepare to fly balloons at Nantes and to demand such extra equipment as would be required. Later in the day, however, Group Captain Carr cancelled these instructions and ordered the detachment to be held in readiness to return to England. Proceeding by road to St. Nazaire, the Detachment embarked on a destroyer on the 16th June, later trans-shipping to the "EMPRESS OF YORK", which arrived at Liverpool during the afternoon of the 18th June, having been bombed unnsuccessfully during the voyage. At Liverpool the detachment entrained for Wilmslow and arrived finally at Cardington.

No.924 Squadron - Evacuation from Havre.

Form 540.

Meanwhile, balloons had continued to fly at Havre. The port and town were subjected to constant enemy raids while mines were dropped in the harbour. Throughout the 3rd June very severe raids occurred and oil dumps and storage tanks were set on fire. During intense enemy bombing an officer with two airmen of the squadron carried out repairs to telephone lines in close proximity to burning oil tanks.

In the early hours of the following morning an enemy aircraft struck a balloon cable, the balloon breaking away at the point of attachment. On examination of the remains of the balloon it appeared that the propeller of the aircraft had come in contact with the flying rigging.

During the next day enemy activity continued on a heavy scale and a number of balloons were damaged but replacements were made and the barrage maintained. On the 8th June demolition parties set fire to oil refineries, but the squadron was instructed not to move until the anti-aircraft units were evacuated. At noon, information was received that mobile guns were to be evacuated and the static guns destroyed while in the evening the balloons were ordered to fly as high as possible under the pall of smoke which now enveloped the town.

The following afternoon the garrison commander gave the codeword that signified that the port was about to be attacked by enemy land forces and preparations for evacuation were commenced, though the barrage was still maintained. All night long enemy aircraft bombed Havre in continuous waves, and quays and buildings were lit up by the burning oil tanks, but fourteen balloons still remained flying on the morning of the 11th June.

The last reserve balloon was inflated with the last remaining trailer of hydrogen at 09.00 hours and flown at 4,500 feet, but during the afternoon no less than ten balloons were shot down by enemy aircraft. The garrison commander ordered all personnel not actually required for defence to be despatched to the Quai Escale for embarkation, and in the late afternoon and evening crews from sites reported at the quai as they evacuated their positions, being joined there by the squadron commander and the headquarters staff. They embarked on the s.s. "VIENNA" which sailed just before midnight. The ship was unsuccessfully attacked by enemy aircraft on its way to Cherbourg and from there the squadron sailed to Southampton on board the s.s. "ST. SEIRIOL". After re-equipment at Cardington, the squadron was retained as a mobile unit.

SECRET

SECTION 5

THE DOVER BALLOON BARRAGE

AHB/IID/34/4/1(A)
~~KBC/S.50069/Ops.~~
Encl. 1A
13/5/40

Alarmed at the determined and successful attacks that were being made on the Train Ferry Docks at Calais following the German invasion of the Low Countries, the Vice Admiral, Dover, on the 13th May, 1940, advised the Admiralty that he was of the opinion that immediate arrangements should be made for a flight of balloons for the protection of the Dover Train Ferry Dock and Marine Station. The Admiralty were of the same opinion and suggested to the Air Ministry that an immediate reconnaissance should be undertaken with a view to making a firm recommendation to the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee.

Ibid.
Encl. 8B.

Headquarters, Balloon Command, were instructed accordingly and eight sites were selected, six being on land and two waterborne, which were considered sufficient to offer adequate protection to the dock. However, on the 16th May, the project was deferred when the Air Ministry informed the Admiralty that they were averse to flying balloons at Dover, unless absolutely necessary, because of the interference the balloons would cause not only to fighter aircraft, but also to Radio Direction Finding and to bombers returning from operations directed against enemy targets in France.

Ibid.
Encl.9A.

AHB/IIH/240/4/134
~~FO/S.20362~~
Encl.1A.

The subject therefore lay dormant until the 16th June when it was again raised by the Admiralty. The fall of Calais on the 26th May had made it even more important that the Royal Navy should maintain effective control of the Straits of Dover. The force with which it was proposed to effect this control consisted principally of the mine barrage, destroyers, motor torpedo boats, minelayers and minesweepers based on Dover. The successful operation of these forces was dependent upon:-

(a) the maintenance of a secure base at Dover.

(b) air superiority over the adjacent waters to prevent interference to surface craft by enemy aircraft operating from aerodromes in the Low Countries and in France.

The Admiralty now asked that immediate consideration be given to the anti-aircraft defences for the base at Dover; and the provision of the maximum possible fighter defence. But it was not until the 29th July, that the War Cabinet Defence Committee (Operations) instructed the Air Officer Commanding-in-Chief, Fighter Command, to examine the proposal to instal a balloon barrage at Dover and if practicable and desirable, to take the necessary action.

Ibid.
Encl.45A

Ibid.
Encl.42A

Air Chief Marshal Dowding decided a barrage was desirable and lost no time in instructing Balloon Command to make arrangements for the immediate move of twenty-four balloons of No.992 Squadron to the town. A further reconnaissance was carried out for the additional sites, and on the 30th July, Fighter Command informed all concerned that part of the barrage would be flying at operational height at 0001 hours on the following morning.

/The barrage

Ibid.
Encl.43A

The barrage consisted of sixteen balloons flying from land sites and eight flying from either buoys or surface vessels. In order that the waterborne balloons should be flying as soon as possible - for Air Chief Marshal Dowding did not consider Dover would be adequately protected until they were flying a signal was despatched to the Commander-in-Chief, the Nore, asking him to release six waterborne balloons, together with barges, from the Thames barrage. The Commander-in-Chief, the Nore, however, considered that the balloons could not be spared without impairing the efficiency of the barrage, but the Admiralty, deciding that Dover must have first priority, instructed him to despatch three drifters and two power barges as soon as possible; these arrived at Dover on the 2nd August.

Ibid.
Encl. 46A
Encl. 49A

Ibid.
Encl. 93A

Meanwhile, Balloon Command had been endeavouring to obtain official approval to the establishment of the new barrage, but on the 6th August they were informed by the Air Ministry that the barrage was only a temporary deployment and for this reason was not to be established.

Balloon Command were somewhat alarmed at this decision as numerous administrative difficulties connected with accommodation and the hiring of land for balloon sites invariably arose when a temporary barrage remained in operation for any length of time. As the result of an appeal for reconsideration through Fighter Command, however, the Air Ministry approval was eventually forthcoming and No.961 Squadron, consisting of three flights of eight balloons each, was formed with effect from the 5th August, 1940, for the protection of the port.

SECTION 6

THE CHANNEL MOBILE BALLOON BARRAGE FLOTILLA

AHB/IID/34/4/4(F)
~~KCB/S.50318/Ops.~~
Pt. VI.
Encl. 14A.

The collapse of France and the consequent occupation by the Germans of the French Atlantic and North Sea coasts at once constituted a grave menace to the operation of shipping in the English Channel. While the Royal Navy could deal with the German Navy, the problem of the German Air Force, now installed at aerodromes all along the French coast, was one that gave cause for considerable alarm.

Matters reached a climax on the 25th July, 1940, when a convoy en route from Southend to Portsmouth was heavily attacked from the air and suffered the loss of eight ships sunk and five damaged.

AHB/IID/34/4/4(A)
~~KCB/S.50318/Ops.~~
Pt. I
Encl. 10A

Clearly, if Channel convoys were to survive, their defences must be greatly strengthened and the Admiralty, making their recommendations in this respect to the Defence Committee (Operations), requested inter alia, that balloon protection should be provided. Approval was forthcoming (1) and on the 28th July, the Director of Local Defences, Admiralty, drew up a preliminary plan to implement what was to be known as the Channel Mobile Balloon Barrage Flotilla.

He considered that eight balloons was the minimum number required to accompany each convoy, and in order to maintain them the barrage should consist of sixteen vessels with two in reserve, working in two divisions each of eight vessels.

As the Commander-in-Chief, the Nore, operated the escort for the Channel convoy, it would be convenient and economical, if the mobile balloon barrage were placed under his operational control, and based on Sheerness.

Report by W/C R.H. Berryman. O.C.No.952 Sqdn.

Meanwhile, in order to save time, instructions had been issued to the Flag Officer-in-Charge, Southampton, to fit out eight tugs with balloon winches and such additional accommodation as would be improvised before 30th July, the date on which the tugs were to be ready to sail. The vessels assigned for the task were French and Belgian tugs and pilot-boats of a nondescript type; these ships being selected as it was at first thought that the mobile barrage would be required only for a short period. Their names were as varied as the ships were motley: "Rene Lebessnerais", "Ingenieur Cashin", "Pingouin", "Pintade", "Gatenais", "Ramier", "Sioux" to quote but a few. All had escaped from either French or Belgian ports and some still had foreign crews. In the opinion of the officer commanding, No. 952 Squadron, Sheerness, on whose headquarters the mobile balloon barrage was to be based, "the whole set-up appeared very ropey".

AHB/IID/34/4/4(A).
~~KCB/S.50318/Ops.~~
Pt.I Encl. 30A
Report by W/C R.H.Berryman, O/C, No.952 Sqdn.

Other problems were also dealt with; the strength of the crews being dependent on the accommodation available, it was proposed that each balloon should be operated by three airmen to be provided by No. 952 Squadron, where a special flight known as 'Q' Flight was formed for this purpose; an air force officer was to accompany each convoy to command the flight and give technical advice to the senior naval officer of the escort; the balloons would be inflated at Southampton by "W" Flight of

/No.930 Squadron

(1) At the D.C.(40) 23rd Meeting

No.930 Squadron, and flown from a stronger cable(1) than that normally used since greater strains would be experienced; the transfer from shore to ship would be effected by flying the balloon from a mobile winch and taking the winch to the ship's berth.

At Falmouth and Sheerness similar arrangements were made.

General Policy

AHB/IID/34/4/4(A)
~~KBC/S.50318/~~
Ops.
Pt.I
Encl.31A.

On the 2nd August, Balloon Command informed headquarters, No.30 Group of the general policy to be followed. It had been decided that the barrage should be based on Sheerness, and would normally escort convoys to and from Falmouth, each journey taking about 2½ days. Between six and twelve hours would be spent at Falmouth before the convoy sailed on the return journey, where any servicing of balloons would have to be carried out.

The positioning of the balloons in the convoy was, of course, dependent upon the number of ships to be protected. The first convoy was to consist of twenty-five merchantmen, disposed in columns of five. A balloon ship was to be stationed fore and aft of the first, third and fifth columns, while one of the two remaining balloon ships sailed after the first three ships in the second column, and the other after the first two ships in the fourth column.

At that time the barrage was not to be established but regarded as an experiment.

The First Convoys.

AHB/IID/34/4/5
~~KBC/S.50318/~~
B.
Encl.1A.

The Channel Mobile Balloon Barrage began its maiden voyage on the morning of the 4th August, five balloon ships proceeding to St. Helen's Bay at 10.00 hours to join the merchant ships which had left Falmouth the previous day. A sixth balloon ship joined them at noon; and a seventh at 13.45 hours. The passage through the Channel was without incident, but served as useful experience and at the same time indicated that not all the balloon ships had a sufficient turn of speed to keep up with the convoy.

Ibid.
Encl.2A.

The passage westward was rather more eventful. The convoy got under way from Sheerness shortly after 08.00 hours on the 7th August, six balloon ships(2) escorting some thirty merchantmen. The balloons were flown at 3,500 feet.

The first eighteen hours of the voyage were without incident. During the hours of daylight a fighter escort of Spitfires patrolled over the ships, while Ansons flew ahead warning the leading vessels if they approached drifting mines. At 02.00 hours on 8th August, the officer commanding "Q" Flight (Pilot Officer A.M. Puckle) noted in his log:

> "Still going with the rear convoy vessels just visible. The stars are many but luckily no moon".

Five minutes later the convoy was heavily attacked by surface craft.

> "There was an explosion astern of us", wrote Pilot Officer Puckle "followed immediately by another and it appeared that both torpedoes had found the same vessel. Immediately the place seemed to become like a Brocks firework display.

/Everybody

(1) KB. 85.

(2) The remainder had engine trouble and were unable to join the convoy.

Everybody that had anything seemed to let it off - tracers showing up scarlet in the night were returned by bullets which appeared green in colour and not one of us knew who was firing at who".

The action lasted some fifteen minutes, and when dawn broke, it was evident that -

"the convoy was to all intents non-existent".

The balloon ships, though somewhat scattered, still survived but

"the convoy has now dwindled to about eight ships and three escorts so that we are considerably over establishment".

The convoy proceeded on its course, and although slowed down by a strong tide passed the Needles at 11.30 hours. At 11.55 hours about thirty German aircraft appeared on the scene. These comprised Ju. 87s with an escort of Me.109s. Their tactics were simple and effective. The convoy was still spread out. Five of the balloons were in correct position, but the sixth, "Astral", in which the flight commander was stationed, had proceeded ahead to carry out experiments in topping up the balloon with hydrogen. Just before the attack commenced "Astral" was a quarter of a mile ahead of the convoy and had turned about in order to rejoin it.

AHB/IID/34/4/4(A)
~~KBO/S.50318/Ops.~~
Encl.60A.

The Me.109s approached at a height of about 8,000 feet. They immediately dived down and made for the balloon ships, three aircraft attacking each balloon and shooting down five. The fighters now withdrew and made way for the dive bombers which attacked from 3,000 feet, all dropping their bombs simultaneously. Subsequently a smaller formation attacked from 1,500 feet, several ships being hit and at least two sunk. The five balloon ships deprived of their balloons put into Portsmouth at 18.45 hours, while the sixth, "Pingouin", flying the sole remaining balloon was ordered to proceed to Falmouth with the remainder of the convoy.

Report by W/C R.H. Berryman O/C.No.952 Sqdn.

AHB/IID/34/4/4(A)
~~KBO/S.50318/Ops.~~
Encl.55A.

First reactions to the effectiveness of protection afforded the ships by the balloons could hardly be other than unfavourable. But the officer commanding, No.952 Squadron (Squadron Leader R.H. Berryman) considered that failure was due to the fact that 3,500 feet was too great a height at which to fly the balloons, for the armament on the various vessels of the convoy was ineffective at this height, while the unusually clear weather on the 8th August had made it easy for the enemy to see the balloons.

Kites.

Ibid.
Encl. 62A

The Admiralty, however, decided that the balloons were not a success and different arrangements were made for the next convoy.

These were as follows:-

(a) Ships to proceed in stages by night, escorted in small groups between Falmouth and Portsmouth, and vice versa, on approximately an eight-day cycle; convoys to be run between Portsmouth and the Thames,

/and vice versa,

and vice versa, during a similar period; each convoy to be limited to twelve ships.

(b) Escort for convoys to consist of a "Hunt" class destroyer and three trawlers by day and, in addition, four motor anti-submarine boats and two French torpedo boats by night.

(c) Ships in convoy to fly kites; the mobile balloon barrage not to be used, but the balloon ships fitted with kites and additional guns to reinforce the escorts.

(d) The convoys to be routed closer inshore; the air force balloon crews to remain on the balloon ships, flying kites from their winches instead of balloons.

For the return convoy from Sheerness to Falmouth it was proposed to experiment with a combined balloon and kite barrage.

AHB/IID/34/4/4(A)
~~KEW/S.50318/~~
Ops.
Encl.3A.

The second convoy left Falmouth during the afternoon of the 17th August. There was insufficient breeze for flying kites but "Pingouin" flew hers for ten minutes by altering course into wind; but as soon as she reverted to the correct course, the kite fell into the sea.

The convoy arrived at Dartmouth the next morning, where it remained during the hours of daylight. On sailing that night there was again insufficient wind to fly kites.

At 06.50 hours on the 19th August the breeze freshened but "Catonais" flew a kite at 1,000 feet with much difficulty. It remained airborne for just under an hour and then collapsed.

The following night, en route for Southampton, "Catonais" made a second attempt to fly her kite, but after five minutes it dived into the sea, and it was not until the evening of the 21st that it was possible to raise a number of kites into the air. By the early morning of the 22nd, ten were flying. This success was short-lived, however, for soon after mid-day, a strong squally wind blew up and all the kites were carried away. The Commander-in-Chief, the Nore, was not at all impressed and promptly signalled the Admiralty recommending that the convoy should revert to balloons.

AHB/IID/34/4/4(A)
~~KEW/S.50318/~~
Ops.
Encl.76A.

The Convoy Reverts to Balloons.

ibid.
Encl.80A.

By the 24th August, the Admiralty had decided that it was desirable that the balloon ships should, after all, fly balloons, but they were also to be fitted to fly kites should the balloons be shot down. In addition, other ships of the convoy were to be permitted to fly kites.

It had now become apparent that if a balloon barrage were to be available to accompany each Channel convoy it was essential that there should be two flotillas, to ensure that time was given to carry out such repairs to the balloons and ships as might be necessary and, incidentally, to enable the crews to be given leave. As the convoy was in future to consist of twelve ships, it was considered that only six balloon ships would be required to accompany each convoy, with two in reserve, one to be stationed at Sheerness, the other at Southampton. All ships were to be fitted with Oerlikon guns.

/A further

A further important decision was reached when the height of the balloons of the convoy was limited to 2,500 feet; that is to say, they were to fly below the effective range of the Oerlikon and twelve-pounder guns.(1)

Ibid.
Encl. 87B

Meanwhile, an enterprising airman (No.841121 Leading Aircraftman Sears) had made out a report of his experiences during the passage of the "Pingouin" from Portsmouth to Falmouth on the 8th and 9th August. The remnants of the main convoy, protected by only one balloon, were attacked by some fifty aircraft. The enemy, adopting the same tactics as before, set about destroying the balloon prior to bombing. But Leading Aircraftman Sears(2) had now decided to use tactics of his own, and when three fighter aircraft opened fire on his balloon -

> "I threw off my brakes and it lifted rapidly and the bullets went through the flying ropes, one of which was badly frayed".

"Pingouin's" balloon endured four more attacks, but by playing it up and down, Leading Aircraftman Sears was able to cause the fighters to miss on each occasion. The balloon finally succumbed to shrapnel holes three hours after attack.

Ibid.
Encl. 88A

The Air Staff at Headquarters, Balloon Command, after examining the report submitted by Leading Aircraftman Sears, were "rather doubtful" whether the action of raising and lowering the height of balloons during an attack was really effective because of -

> "the disproportion of the relative speeds of aircraft and balloons".

Report by W/C
R.H.Berryman
O/C.No.942 Sqdn.

However, they had no objection to the convoy using this method of defending the balloons. This was just as well as these tactics subsequently became the standard method of protecting balloons of the convoy when they were attacked, and according to the officer commanding, No.952 Squadron, few balloons were hit and enemy aircrews -

> "were satisfied to drop their bombs away above the balloons".

AHB/IID/34/4/4(A)
~~KBC/S.50318/Ops.~~
Encl.118A

By September it had been decided that the balloon ships should only escort the Channel convoy between Sheerness and Southampton and back. In addition, the height of the balloons was now limited to 2,000 feet, the Admiralty having ruled that high explosive shells for anti-aircraft guns in merchant ships should be set to burst at 2,500 feet.

Ibid.
Encl. 126A

Ibid.
Encl.137A

On the 9th September, a convoy was again subjected to air attack. The ships were sailing in single line ahead, and in front of the leading balloon ship "Astral", were a

/destroyer

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(1) Both these types of gun were effective at 3,000 feet.

(2) Leading Aircraftman Sears was subsequently awarded the Distinguished Service Medal, a unique honour for an airman.

destroyer, two armed trawlers, and a merchant ship flying the flag of the commodore. The first enemy aircraft to appear were three Me.109s and it was clearly their intention to shoot down the balloon flown from "Astral". Their arrival was greeted by heavy fire from the escort ships and two of the aircraft withdrew. The third made three attacks on the leading balloon which was played up and down. Prior to the final attack the balloon had been lowered to 1,200 feet and was now let up rapidly to 2,000 feet. This so upset the calculations of the enemy pilot that he had to climb hard to avoid a collision.

Some fourteen minutes later about twenty dive-bombers attacked the leading ships of the convoy, but no attempt was made to bomb astern of "Astral" and in the opinion of the Officer Commanding, No.952 Squadron -

> "the dive bombing was not continued on other merchant ships in the convoy, owing to the fact that a balloon was still flying between the leading escort ships and the remainder of the convoy".

On the return convoy, "Astral" was placed ahead of all other ships except the Minesweepers and when once again the convoy was subjected to air attack by two aircraft, "Astral" was the main target for their bombs, the nearest of which fell 300 yards to starboard astern.

AHB/IID/34/4/5
~~CBC/S.50318/B/~~
Ops.
Encl. 10A

By October the enemy, chagrined at the failure of their air attacks against the Channel convoys, unleashed another weapon in an effort to stop their passage through the Straits of Dover. On the 11th October, a westbound convoy was the target for over 200 shells fired from the French coast. While the shelling was accurate, ships being straddled on many occasions, no ship suffered a direct hit. Five of the six balloon ships were slightly damaged.

Ibid.
Encl.160A

The Commander-in-Chief, The Nore, considered it was not improbable that the accuracy of the enemy guns was achieved by the use of radio direction finding apparatus directed on the balloons or their cables. He therefore issued instructions for the balloons of future convoys to be close-hauled to the minimum height when passing through the Straits in the hope that balloons flying below the height of the Dover cliffs would not be "picked up" by enemy radar.

Whether the lowering of the balloons in the Straits did, in fact, have an effect on the accuracy of the enemy long-range guns is a moot point, but it became a routine operation on each convoy, and no ship was ever hit by a shell, although many were superficially damaged by splinters. Casualties were also suffered by the crews. On one occasion a naval officer on duty on "Fratton" recorded in his log four flashes seen from the French coast and seventy seconds later was killed when one of the shells burst over the ship.

Report by W/C R.H.Berryman, O/C.No.952 Sqdn,

The sailings of the convoys had by this time become regular; air attacks were few and far between; and while the shelling was not regarded with relish, the ships' crews carefully counted each shell and, like spectators at Lords, religiously applauded when the score reached fifty.

Interview with F/Lt. A.D. Forster, O/C "Q" Flight.

/On the 27th October

AHB/IID/34/4/4A
~~KBC/S.50318/Ops.~~
Encl. 64A

On the 27th October, Balloon Command informed No.30 Group that a further change was to be made in the composition of the mobile balloon barrage. Ten vessels were to be provided for the barrage, of which up to eight would sail with the convoy at any one time, the actual number being dependent on the size of the convoy and determined by the Commander-in-Chief, The Nore.

Report by W/C R.H.Borryman O/C.No.952 Sqdn.

Of the original balloon-carrying vessels, two(1) had been paid off as unfit for service, a third(2) transferred to other service, and a fourth(3) sunk. Other more suitable ships were fitted out including the Southern Railway Cross-Channel ships "Fratten" and "Haslemere", and the accommodation on the other ships was considerably improved. One some of the ships, where the winch was placed close to the mast, an iron ring about four feet in diameter was fitted to the masthead to prevent the balloon cable from fouling it when the wind changed.

Ibid.

The servicing of the balloons at Sheerness had proved difficult, as the balloon ships were not able to berth alongside the servicing bed as at Southampton. A large motorised barge, "Helen Birch", was fitted out, therefore, to transfer balloons from the ships to the servicing bed, and vice versa; a special bridge being built aboard her to prevent balloons from fouling funnels and masts during transfer.

Ibid.

The convoys continued to sail east and west throughout the winter of 1940/1941 and the operation became a comparatively uneventful one. The formation of the convoys was regularized; there being six "Tree" type sweepers ahead, then the first balloon ship, two destroyers of the "Hunt" class on the seaward side, then three or four merchant ships, followed by another balloon ship, more merchant ships, another balloon ship, and so on, the escorted number of ships being evenly spaced between the balloon ships. When off Margate six or eight anti-submarine motorboats took up position on the seaward side of the convoy where they remained until the end of the run.

AHB/IID/34/4/4(F)
~~KBC/S.50318/Ops.~~
Pt.VI.
Encl. 14A

Further ships were replaced at the end of the first winter, mainly as a result of heavy weather, and three more Southern Railway Ships were equipped for the work(4), and the convoy continued to operate throughout the following summer and winter.

In August, 1942, the Commander-in-Chief, The Nore, forwarded a summary of the activities of the Channel Mobile Balloon Barrage Flotilla for the information of the Lords Commissioners of the Admiralty, pointing out that:-

/"it had

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(1) "Ingenieur Cashin" and "Sioux"

(2) "Indefatigable"

(3) "Porealis"

(4) "Sambur", "Deal", "Roebuck".

"it had sometimes proved difficult to induce Masters to sail during the very heavy air attacks which were being experienced at this time, but the increased escort, and in particular the appearance of the Channel Mobile Balloon Barrage, seemed to have a very heartening effect on the Masters' morale".

Two hundred convoys comprising over 3,000 merchant ships had been escorted; an average of 6.6 balloon ships operating on each occasion. The convoys had suffered attack by air on twenty-three occasions, and by "E" boats on three occasions, while the danger from mines was ever present. The German long-range guns had engaged the convoys forty-eight times, firing well over 2,000 shells. Ten merchant ships had been lost, five as the result of mines. Fifty-two awards had been made to officers and men of the convoys, including nine to Royal Air Force personnel.

One hundred and one balloons had been inflated. Of these twenty had been lost as a result of enemy action, four by lightening on voyage, and twenty-three due to gales. The record was a good one.

The flotilla continued to sail up and down the Channel for a further nine months and the long-range guns continued to fire at, and miss, the ships, while mines were still laid in the path of the convoys. The increasing strength of allied airpower, however, was beginning to tell. By the beginning of 1943 the German Air Force no longer ventured out in force over the Channel during the hours of daylight and in consequence balloon protection became unnecessary.

On the 13th May, 1943, the Channel Mobile Balloon Barrage Flotilla, having completed one hundred and sixty-six runs in each direction, put into Sheerness for the last time. The value of this contribution to the final victory cannot be assessed, but there is little doubt that without it allied shipping would have been unable to pass through the Straits of Dover during the critical years of 1940/1942.

/SECTION 7

SECTION 7.

OPERATIONAL FLYING POLICY.

CS.1396 Encl. 1B 11/5/39

The first discussions on the operational control of balloon barrages took place in the spring of 1939 when, on the 11th May, a conference was held at Headquarters, Fighter Command, with the Air Officer Commanding-in-Chief in the Chair. Air Chief Marshal Sir Hugh Dowding said that, broadly speaking, the balloon barrage would go up at the outset of war and would remain up night and day throughout hostilities, except possibly in gale of thundery conditions inimical to balloons. Balloons would normally fly at their maximum height; when clouds were below this height the balloons would be flown in the clouds.

It was recognised, however, that certain limited controls would be required over balloon flying. For instance, selected balloons would be grounded in the Hornchurch area when visibility hampered the operations of aircraft from there, and similar controls would be exercised in the Tyne, Tees and Humber areas, but these were exceptions.

CS.1396 Encl.14B 25/8/39

Air Staff Instructions(1) were issued on the 25th August, 1939 implementing the conference decisions. Operational control over the balloon barrages would be exercised as follows:-

Fighter Command
I
Balloon Command
I

Provincial Groups	London Groups
I	I
Centres	Squadrons
I	I
Squadrons	Flights
I	I
Flights	Certain Sites

From this basic idea of permanent flying in the case of possible attack, evolved the policy of permanent grounding except in the case of probable attack - a policy subject, of course, to modification and adaptation to local circumstances, but which never lost sight of the desirability of keeping the sky as free as possible from obstructions to our own aircraft.

The most important immediate reason for modifying the original policy was the serious wastage of balloons and equipment through weather conditions, while, later, improved communications coupled with the ever-lessening threat of air attack on the one hand, and the increasing number of fatal accidents to friendly aircraft, caused through faulty navigation

/on the other,

(1) It is unfortunate that Balloon Command Air Staff Instructions Part 1 (Operations) are complete only in so far as the latest instructions are concerned. As the various instructions were implemented, modified or replaced, the obsolete instructions were destroyed, and there does not now appear to be any record of any original or intermediate instructions for reference purposes. There was an original series numbering 1 upwards, which were substituted by a new series numbering 101 to 128, of which there remain today only numbers 111-113, 115-129. These will be found in Appendix 'N'.

on the other, combined to hasten the swing of the pendulum towards the grounded policy.

Breakaway Balloons

Data supplied by Balloon Command

Even before the outbreak of war it was recognised that balloons breaking away from their winches and trailing cables across country would cause great dislocation of industry through fusing high tension electric cables, and at the Balloon development conference held at Cardington in July, 1939, it was therefore decided as an urgent requirement that a device should be developed to rip a balloon immediately it broke away from its moorings. The result was an inertia link submitted for service trials at the beginning of 1940, and put into full-scale production later in the year. The device was simple and worked successfully, on the whole, when properly serviced.

AHB/IID/54/1/5(8)
~~KBC/S58845~~
9/4/40

Balloon Command F540 6/10/39

In October, 1939, there was no such safety measure, and after a spate of casualties through lightning, and breakaways which caused the anticipated extensive dislocation of industry by the interruption of electric supplies, all groups were instructed by Headquarters, Balloon Command to take greater precautions against losses due to the weather. Breakaway balloons(1) were in fact such a menace that great care had to be taken to reduce this risk, and prompt arrangements made to shoot down any balloons that were adrift. Even one balloon could cause wide havoc.

Balloon Command Air Staff Instructions Part 1 Ops. Serial No.113 1/4/41

In the event of a breakaway, the nearest control centre of the Central Electricity Board had to be telephoned at once, particulars being given of height, direction of travel, length of trailing cable, and time and place of breakaway. Any such balloons likely to drift over Eire had in addition to be reported without delay to Balloon Command, in order that the appropriate authorities in that country might be warned.

Balloon Command F.540 27/10/39

Barrage Control Decided Upon

The first step towards the institution of organised flying discipline was the decision to control each barrage by a single authority; in the case of London the barrage commander, as he was to be called, would be the Air Officer Commanding, No. 30 Group, while in the provinces he would be the officer commanding the centre within a radius of five miles, or if outside that distance, the senior squadron commander. All squadron commanders, however, would retain the right (rarely exercised in practice) to reduce the height of, or ground, their balloons in emergency.

This decision entailed the setting-up of an operations room for each centre or barrage, staffed to maintain a continuous watch divided into three shifts, each under the command of a barrage control officer of the rank of flight lieutenant. A two-day course was held at Headquarters, Balloon Command, on 12th and 13th February, 1940, for the first group of officers selected, the syllabus including lectures on the functions and layout of operations rooms; the operations of balloon barrages in war; various types of control; co-operation with local defences; reporting balloon casualties and breakaways; the keeping of log and operations record books and the making of returns; maps and co-ordinates; and meteorology. This was an ambitious syllabus to cover in a brief two days, but the subject

Balloon Command F.540 12/2/40

/matter

(1) For further information regarding breakaway balloons and the Central Electricity Board see Appendix "L".

matter was only handled in a general manner, the intention being to start the budding controllers on the right path rather than to indicate the end of the road.

AHB/IIH/240/4/139
~~FC/S.23547~~
Encl.137A
11/4/40

With the establishment of the operations rooms early in 1940 came the need for quick and reliable communications. Telephone lines already radiated from the operations room at Fighter Command to those at fighter groups and thence to anti-aircraft gun operations rooms. It was now a matter of extending the lines from the latter to all balloon sites via the operations rooms at balloon barrages and to squadron and flight headquarters.

AHB/IID/34/4/8
~~KCB/S.50900~~
Encl.39B
16/4/41

Time showed that the system worked quickly and efficiently.

Early Air Staff Instructions.

FC/S22422
Encl.26A
26/3/41

Once it was decided to decentralise the control of flying it became necessary to frame rules to guide barrage commanders. At first these were rigid, but with the mellowing effect of experience came a greater latitude of discretion. Originally, when balloons were grounded in unsuitable weather, it was laid down that they would immediately be flown on a Home Office "yellow" or "red" air raid warning. Later, with a change in the policy of the Home Office to give yellow warnings more freely, permission was accorded to the barrage commander to exercise his discretion whether or not to fly on receipt of such a warning. Later still, he was empowered to keep all balloons grounded even on a red warning, should he consider circumstances to justify such an extreme step. In fact, this discretion weighed heavily upon the shoulders of barrage commanders who usually chose to fly, whatever the weather, sometimes with disastrous consequences, when enemy aircraft were in the neighbourhood, for fear of being caught grounded in an attack on their particular areas. It frequently happened that the enemy passed many miles wide of the barrages, so jeopardised, on their way to another objective.

The Introduction of the Plotting System.

KBC/S54825
7/7/40

On the suggestion, therefore, in July 1940, of the Air Officer Commanding, Balloon Command, to overcome this difficulty, it was arranged that barrage commanders should receive the plots of enemy aircraft as broadcast over the Fighter Command system, and ignore the Home Office warnings unless there was a breakdown in communications between the local anti-aircraft gun operations room and barrage control room. The Home Office warnings system thus became the second, instead of the only, string in the communications bow, and the arrangement was certainly an improvement. The more complete view of the tactical situation thus afforded to barrage commanders naturally enabled them to exercise their discretion with greater confidence.

Controls.

FC/S16281
Encl.182A
4/6/40

As the restrictions on flying balloons increased as the war progressed so, too, did the various types of control, the first of which, with a general scope, was brought about by the Air Officer Commanding-in-Chief, Bomber Command (Air Marshal C.F.A. Portal), who, in June, 1940, asked that the east coast barrages should be close-hauled at nights

/when

when his bombers were out over the Continent; he pointed out that navigational difficulties in bad weather were great and that on recent occasions three aircraft of Bomber Command had impacted British balloon cables, two with fatal results. He concluded -

> "...the total casualties inflicted on the Hampdens of this Command by our own defences in this country exceed the total number suffered at the hands of the enemy during night operations, and if this continues it must have a most serious adverse affect on morale".

ibid.
Encl.7A.
8/6/40.

The reaction of the Air Officer Commanding, Balloon Command, to the suggestion, was swift. He pointed out that one of the two fatal impacts mentioned by Air Marshal Portal took place at Coventry and was incorrectly described as a casualty to an aircraft returning from an overseas operation. Emphasizing that barrages close-hauled, for the safety of our own aircraft, could not be made reasonably operational if they were only to fly on a yellow warning, he ended his letter on a vigorous note -

> "...it will be seen that only in one instance has a balloon cable been the cause of bringing down one of our own bombers returning from abroad. This figure is of course extremely small in relation to the number of flights made, and I consider represents a degree of risk inevitable in war operations. I suggest, therefore, since balloons have contributed in such a minor degree to the alarming statement in the last paragraph of Bomber Command's letter, that to render the east coastal barrages ineffective is hardly warranted".

AIR/11H/240/4/138(B)
~~FO/S16281~~
Encl.188A.
11/6/40.

The contribution to this question by Air Chief Marshal Sir Hugh Dowding was that, though he personally would be delighted to dispense with balloons altogether on the east coast, since they were just as dangerous to fighters as bombers, he did not think that such a drastic step could be contemplated as to close-haul on the lines suggested by Air Marshal Portal.

ibid.
Encl.195A.
13/6/40.

ibid.
Encl.198A.
13/6/40.
ibid.
Encl.207A.
13/6/40.

The matter was decided on the 15th June when an Air Ministry signal was despatched, ordering all balloons in the Harwich, Humber, Tyne, Tees and Blyth areas to be close-hauled, at the discretion of Fighter Command, on nights when bombers were returning from sorties. They would be close-hauled at dusk and flown again at dawn. Waterborne balloons (which could not be close-hauled owing to technical difficulties) would be flown at 1,000 feet during the same period.

This was indeed a wide control and a foretaste of what was to come; that it was imposed at all showed the respect in which the balloon defences of this country were held by the aircrews- a respect only too well justified by the many casualties that subsequently occurred.

In addition, the summer of 1940 found the following controls in operation:-

Note by Balloon Command Air Staff. Feb.1945.

(a) Fighter Operational Control. Granted to operational units over specified balloons in order to facilitate active operations against the enemy. Once imposed it remained in force until released by the controlling authority irrespective of enemy plots in the neighbourhood.

(b) Gun Operational Control. Granted to Anti-Aircraft Command over certain balloons at night when the balloon cables interfered with their instruments.

(c) Local Safety Control. Granted to civil or service aerodrome controllers where the safety of aircraft was affected. Frequently only certain balloons were affected, either singly or in lanes, according to wind direction. The control was granted, refused or released by the barrage commander in accordance with the tactical situation.

(d) General Purpose Control. Imposed and released only by Fighter Command.

(e) Gun Calibration Control. Imposed for the benefit of the gun and searchlight defences and released by the barrage commander if the tactical situation required it.

(f) S.O.S. Control. Imposed by fighter groups to assist friendly aircraft in difficulties.

(g) Air Co-operation Control. Granted to anti-aircraft defence commanders for training purposes and released by the barrage commander if the tactical situation required it.

A.S.I.'s Pt.1. (Ops) Serial 119 16/12/42.

These controls remained in force throughout the war though they became more standardised. By the end of 1942 controls were called "standing" or "general purpose" and were imposed either as "terminable" or "over-riding." Standing controls were arranged between the controlling authority and the barrage commander concerned once the initial authority had been granted by the local fighter group, while general purpose controls were imposed by the balloon liaison officers(1) at fighter groups on behalf of the fighter group controller.

The barrage commander was authorised to release terminable controls upon threat of enemy action, but had no jurisdiction regarding over-riding controls even in the event of attack on his particular target area, unless (a) communications had broken down and heavy attack developed, or (b) the control was in the hands of the anti-aircraft defence commander, when it was his responsibility, or the barrage commander's on his own information or if notified by the balloon liaison officer, to release it at once on becoming aware of the approach of enemy aircraft below 5,000 ft.

AHB/IIH/240/4/139 ~~FO/823517.~~ Encl.9A and 9B. 30/3/41.

Toll of Friendly Aircraft.

With the increasing momentum of flying training came an alarming increase in the number of incidents involving both trespasses of barrage areas and impacts with balloon cables. Indeed, the Air Council became so concerned that they

> "reached the conclusion that the policy governing the operation of this form of defence must be reviewed, as a matter of urgency, in order to reduce this toll on our air effort."

The question was accordingly put to Fighter Command in March 1941 and thoroughly investigated. The difficulty throughout the war with balloon barrages was to reconcile irreconcilabilities - to reconcile the need for the permanent flying of balloons to achieve the fullest protection possible

/from

(1). See pp.267-269

from this form of defence on the one hand, with the need for keeping the sky as free of obstructions as possible to friendly aircraft on the other, and any solution could only be a compromise to the detriment of both.

ibid. Encl.13A

From the outbreak of war to the 25th March 1941, there had been a large and increasing number of infringements of barrage areas, including no less than 91 impacts of balloon cables by friendly aircraft, more than half in broad daylight. These impacts resulted in 81 fatal casualties to flying personnel involving the loss of 38 aircraft, and the serious damage to another 21, while the remainder escaped with minor damage. In addition, there had been reported the disturbing number of 50 penetrations by friendly aircraft of barrage areas, without impacting cables, during the first 25 days of March alone.(1)

Analysis showed that 27 out of the 36 barrages flying at that time were involved in all these incidents, which indicated that the problem was a general one, and not confined merely to operational areas. In fact, the majority of the penetrations were caused by training and other non-operational aircraft.

Pilots at Fault

Primarily, pilots were to be blamed for this state of affairs.

> "After all, this is not unlikely as they, and particularly the pupils are relatively young and reckless and still need education. We do not relax the blackout at night so as to prevent careless people falling down holes; instead we carry out constant propaganda. Similarly we should not cripple an essential form of defence to save our pilots; rather should we intensify their education in this particular matter."

wrote Lieutenant Colonel Burlton, the Fighter Command staff officer who made an appreciation of this problem.

ibid. Encl.9B. 30/3/41.

The Air Ministry proposal was that, apart from the control already discussed whereby east coast barrages could be close-hauled on nights when our bombers were on operations over the Continent, certain barrages should be grounded at night (considered for this purpose as one hour after sunset to one hour before sunrise) as a routine, and subject of course to the activities of the enemy. The remainder, in view of their exposed position, were not as a general rule to be close-hauled at nights. Waterborne balloons, because of the special difficulties

/attending

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(1) Too hasty conclusions should not be drawn about the efficiency of balloon barrages from this figure, for many of the incidents involved an aircraft flying only between two balloons on the perimeter of a barrage. Further, it is known that some incidents reported were in fact not infringements at all, since the aircraft were above the height of the balloons, while it is equally true to say that other cases of infringement escaped report through non-observation. To gauge relative height is difficult for the inexperienced ground observer.

Another important factor affecting penetrations of barrage areas also needs to be taken into consideration. In the case of the smaller barrages expressly intended to protect one or more vulnerable points, balloons were sited to preclude a bombing run over these special targets from any direction, quite possibly leaving lanes or wide spaces across the barrage area through which a trespassing aircraft could fly with a greatly lessened chance of striking a cable (see Part I pp.147.)

attending their handling, would not be included in these proposals.

ibid.
Encl.13A.

Fighter Command's reactions, apart from disagreeing with details of the distribution of the barrages into the above categories, were that the various controls in force adequately covered the idea behind the Air Ministry's proposals without their inflexibility, and strongly recommended among other things that their new operational instruction No.74, recently promulgated, should be given a thorough trial, as it had been compiled only after careful thought and experience, and that an intensive educational campaign should be launched through all levels down to embryo pilots.

> "As we do not mind in the least how much the enemy knows about our balloons, which he obviously respects, part of this campaign should include a broadcast by the Air Ministry to all aerodromes without exception, to all Royal Air Force units and civil contractors and to all duty pilots of a non-secret detailed map or maps showing the perimeters of every established barrage in the British Isles."

ibid.
Encl.16A.
6/4/41.

Balloon Command, commenting on Fighter Command's views on the matter, found themselves in complete agreement. In fact, the only comment made by the Air Officer Commanding was a small though significant one, a sidelight on the effect balloons exercised on public morale -

> "I do not know whether you are aware that it is the fact of our balloons being flown during the hours of darkness which has induced the workmen at Vickers, Weybridge, to resume work during those hours."

Air Council Reassured.

ibid.
Encl.24A.
1/5/41.

The Air Council, reassured that the Air Officer Commanding-in-Chief, Fighter Command, held the question of balloons continually in mind, were content to leave the matter in his hands without further demur. They were perhaps not unaware of the prejudice against balloons excited in the breasts of all airorews, and were satisfied that there would be an ever-present tendency to take every possible precautionary step to ensure the safety of aircraft and their crews, including the grounding of balloons under controls.

AIR8/II H/240/4/145
~~FO/322422~~
M.33.
1/4/41.

This aspect did not escape the attention of the Senior Air Staff Officer, Fighter Command (Air Vice-Marshal E.C.S. Evill) who observed in April -

> "I still notice a tendency in these minutes to assume that it is our object to fly balloons as little as possible, whereas the C-in-C has laid down quite clearly that it is our purpose to fly them by day whenever practicable."

Flying Policy Reviewed.

S.4449
DF.Ops.
29/10/41.

With the autumn of 1941 operational balloon flying policy was again reviewed as the result of increasing infringements of barrage areas by friendly aircraft and on the 29th October, 1941 the Deputy Chief of the Air Staff

/(Air Vice-Marshal Bottomley

(Air Vice-Marshal Bottomley) wrote to the Air Officer Commanding-in-Chief, Fighter Command (Air Marshal Sir Sholto Douglas) on the subject. With the earlier decision to close-haul all except certain coastal balloons during the hours of darkness unless enemy aircraft were in the neighbourhood, it was natural that there had been a considerable reduction of the number of penetrations by night. By day, however, the position had deteriorated, and in October there had, in addition, been an increase in the number of collisions with cables, seven out of eleven proving fatal.

The suggestion Air Vice-Marshal Bottomley now put forward was that balloons should be grounded by day as well as by night, at any rate during the continuance of the existing state of enemy air inactivity. This policy would increase the risk of surprise attack by isolated cloud-flying enemy aircraft, but as the enemy had not lately been adopting these tactics, it was a risk considered justified in the circumstances, and in the meantime incidents involving the loss of valuable lives and material would be avoided. A resumption by the enemy of this form of attack would naturally bring about a review of this policy.

AHB/IIH/240/4/39
~~FC/S23517~~
Encls. 74A & B
13/10/41.

Balloon Command's Proposals to Close-haul Balloons.

The Air Officer Commanding, Balloon Command (Air Marshal Sir Leslie Gossage) was also thinking along the same lines at this time, and put forward similar suggestions to the Air Officer Commanding-in-Chief, Fighter Command on the 13th October, 1941. He remarked that as the allied air offensive increased, considerably more limitations would have to be placed on balloons flying owing to the danger to friendly aircraft, and he went on to postulate that balloons should be kept grounded day and night except when enemy air attack threatened and examined ways and means of making this practicable.

Reviewing the situation from the outbreak of war, he recalled that the policy governing balloon operation was to maintain a lethal cable barrage under all practicable weather conditions. Experience soon showed that this policy caused embarrassment to commands engaged in operations and training, hampering their scope and resulting in serious casualties to friendly aircraft. The antidote was a system of controls which were intended not only to safeguard friendly aircraft but also to remove radio interference with anti-aircraft gun instruments.

The current policy for operating balloons was briefly:-

By day — To fly at all times except when under a control and no likelihood of excessive casualties from the weather. To run greater flying risks under conditions of low cloud (i.e. cloud base less than 5,000 feet) favouring surprise attack. To fly, on a hostile plot, balloons under a control except when they would hamper the operation of friendly fighters.

By night — To ground balloons, unless an attack threatened below their maximum operational height.

/The whole

The whole question of extending the grounded policy turned on the speed with which balloons could attain operational height and, closely connected with it, the problem of communications. The effect on civilian morale had also to be weighed.

As the result of technical improvements[1] in mooring and handling balloons, experience showed that they could be raised from surface to 4,000 feet in nine minutes, while with the best communication facilities an operational order from a barrage control room to all sites took three minutes. Thus, the minimum time required to raise balloons to 4,000 feet was twelve minutes, but it was considered desirable that a warning period of fifteen minutes should be provided. At that time, however, the average warning time was only about eight minutes, except in the case of No.30 Group (London) which received its information direct from No.11 (Fighter) Group, whereas records showed at least a fifteen minutes warning as a general rule. This latter chain of communication should, therefore, be adopted as far as practicable. In so far as civilian morale was concerned, it was thought that if balloons were at operational height by the beginning of a raid, any criticism of the grounded policy could be met without difficulty.

With balloons equipped with the latest improvements the proposal was that barrages generally should be permanently close-hauled; that manned waterborne balloons should fly at 1,000 feet by day and at ruling operational height[2] at night; that unmanned waterborne sites (Mark VI balloons) should fly permanently at operational height. It was recognised that coastal barrages, where sufficient warning might not be found possible, might have to be treated differently, and naval objections to the new proposals were to be expected.

AH8/11H/240/4/139
~~FC/S23517~~
Encl.98A
13/11/41.

Fundamental Change in Flying Policy Approved

A conference was held at Headquarters, Fighter Command, on the 7th November to consider the whole question, and the proposals were accepted in principle, though Air Marshal Douglas was apprehensive regarding the coastal barrages which he considered should continue to fly as much as possible. Air Marshal Gossage, however, drew attention to the fact that controls in many barrages already resulted in a semi-permanent grounded state. In the end it was decided that the

/following

(1) The most important single improvement was the double parachute rip link (DP/R link) which combined the devices for cutting the cable and ripping the balloon if it broke away, and freeing the top parachute in the event of an aircraft impacting the cable. This DP/R link was permanently fitted to the cable at the point of attachment to the balloon which could accordingly be paid out to operational height from the close-hauled position without the crucial delay occasioned by stopping it at about 300 feet for the fitting of the normal double parachute link (D.P.L.)

(2) Ruling Operational Height (R.O.H.) "is the height at which Balloons are to be flown in Air Raid conditions. It is to be selected by the Barrage Commander and is to be known at all times by the N.C.O. or airman i/c of every site, irrespective of whether balloons are flying or not."

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G.192400

following barrages would, in principle, be flown day and night:-

First Line Barrages.(1)

Thames Estuary
Dover
Harwich
Harwich (App.Channel)
Pembroke Dock
Milford Haven (App.Channel)
Southampton and Eastleigh
Southampton (Anti-Minelaying)
Portsmouth
Portsmouth (App.Channel)
Plymouth
Plymouth (App.Channel)
Falmouth
Falmouth (App.Channel)
Portland (App.Channel)
Poole (App.Channel)
Hull
Humber
Newcastle
Newcastle (App.Channel)
Blyth
Blyth (App.Channel)
Billingham
Hartlepool (App.Channel)
Scapa
Forth
Belfast
Belfast (App.Channel)

The remaining barrages would, in principle, be grounded day and night, at a date to be determined later:-

Second Line Barrages.

London
Weybridge
Langley
Cardiff
Newport
Barry
Swansea
Port Talbot
Brockworth
Avonmouth
Filton
Bristol
Weston-super-Mare
Yeovil
Birmingham North
Birmingham South
Coventry
Liverpool (Outer Mersey)
Barrow
Barrow (App.Channel)
Runcorn
Crewe
Manchester
Accrington
Derby
Sheffield
Glasgow
Clyde
Ardeer
Methil
Londonderry
Lisahelly

To ensure that public morale should not suffer, and that crews should maintain a high standard of efficiency in balloon handling,

/it was laid

Balloon Cmd. ASI's. Pt.1. Ser.No.117. App."A".

(1) For purposes of comparison, the final list of first and second line barrages, at the beginning of 1944, is appended below :-

First Line Barrages

London
Langley
Weybridge
Dover
Thames
Harwich
Portsmouth
Southampton
Canterbury
Chelmsford
Yarmouth/Lowestoft
Norwich
Plymouth
Falmouth
Yeovil
Dartmouth (Mk.VI)
Hull
Humber
Newcastle
Billingham
Sunderland
Forth
Scapa

Second Line Barrages

ibid. App.B.

Weston
Bristol
Brockworth
Cardiff/Barry
Newport
Swansea/Port Talbot

it was laid down that in the case of the grounded barrages the balloons should be flown to ruling operational height at least twice a week.

AHB/II H/240/4/147
~~FO/S26638~~
Encl.19A
13/11/41

Before putting into effect this radical change of policy it was necessary to hold a full-scale trial, and the experiment was made with the barrages at Bristol, Avonmouth, Filton, Brockworth, Yeovil and Weston-super-Mare (all based on No.11 Balloon Centre, No.32 Group) linked up via group headquarters to No.10 (Fighter) Group Operations Room at Rendloe. In case of breakdown of this line of communication there was the existing line, fighter group - gun operations room - barrage control room, which would continue to be used in order to keep barrage commanders in the tactical picture as well as to provide them with necessary information for the operation of decoys.(1)

ibid.
Encl.66A
20/1/42

By the 20th January, 1942, Air Marshal Gossage was able to report favourably on the experiment, the only difficulty having been poor reception over some of the lines. He recommended that the system should be extended to all balloon barrages in the country.

ibid.
Encl.79A.
31/1/42

In acquainting the Air Ministry of the success of the experiment and of his decision to make the system general, Air Marshal Douglas stated that the first line barrages would normally be flown at 1,500 feet.(2) This height was a compromise, precluding a surprise attack at a very low height, while providing less of a danger to friendly aircraft. There were, however, a few exceptions to the new instructions. Dover, Plymouth and Harwich were to continue to fly at full operational height whenever possible, while the Northern Ireland barrages were to be operated at the discretion of the Air Officer Commanding, No.82 (Fighter) Group, and the Scapa Barrage was to continue under the operational control of the Admiral Commanding, Orkneys and Shetlands.

AHB/II H/240/4/147
~~FO/S26638~~
Encl.109A
6/3/42

ibid.
Encl.80A
31/1/42

A concession to second line barrages provided that, if weather conditions permitted, balloons might be flown at 500 feet. This enabled a certain amount of training to be carried out during any spell of calm weather, and also ensured a greater state of readiness.

Balloon Officers

AHB/II H/240/4/147
~~FO/26638~~
Encl.19A
15/11/41

These developments had made it necessary to provide a permanent watch in group fighter operations rooms by specialist officers, known as balloon officers, whose duty it was to control all barrages (under the group controllers) as the tactical situation required.

AHB/II H/240/4/138(B)
~~FO/S16281~~
Encl.107A
19/12/39

As early as December, 1939, the question of establishing a balloon liaison officer from Balloon Command at Fighter Command was raised by the Air Officer Commanding, Balloon Command, in order that the operations officers at his Headquarters might be kept closely acquainted with all enemy

/air activity

(1) For further information about decoys, see page 461.

(2) At this height the balloons generally were fully armed. For further information on "series" arming, see pp.

air activity and thus enable them in their turn to give early warning of possible attack to any barrage that was at the time close-hauled for weather reasons. He withdrew his suggestion, however, in March, 1940, on being informed of the extremely heavy work entailed in linking up by telephone all barrages direct with Balloon Command.

ibid.
Encl. 12
5/3/40.

ibid.
Encl.137A
11/4/40.

The next month, however, on the instructions of the Air Officer Commanding-in-Chief, Fighter Command, a trial was made of stationing a liaison officer from Balloon Command in the Fighter Command operations room. His duties were to watch the progress of enemy raids, and to pass flying orders direct to the coastal barrages of Newcastle, Billingham, Hull and Harwich if these were grounded because of the weather, since they could not be raised to operational height in time to be of practical use if they had to wait till receipt of the yellow warning. For the second time the idea was abandoned, since it was found on further trial that messages could be telephoned satisfactorily from the floor supervisor's line to the group supervisor who repeated it to the gun liaison officer for transmission to the barrage concerned. It was established that such messages could be passed on an average in two minutes, but when this method of passing operational messages was put to practical test later in the war, it was found unsatisfactory, and abandoned.

ibid.
Encls.148A &
149A.
29/4/40
AHB/II/H/240/4/139
~~FO/823547~~
Encl.74A.
13/10/41.

With the final re-introduction of balloon officers at fighter groups their duties were closely defined, and by being able to give their whole attention to the tactical situation as depicted on the operations room table they were able to pass operational instructions with all possible dispatch. Four simple operational instructions were used:-

Standby: meaning that a dangerous plot was approaching the barrage area but not sufficiently close or definitely dangerous to raise the balloons.

Stand-down: meaning that the danger from the plot had passed.

Shine: meaning that the barrage was to be flown at once at the ruling operational height already determined by the individual barrage commanders and in accordance with Balloon Command Air Staff Instruction.

Dull: meaning that the danger had passed and that the balloons were to be lowered again as quickly as possible.

ibid.
Encl.
28/4/42
ibid.
Encl.149A
6/5/42.

ibid.
Encl.154A
9/5/42

There was more than one attempt by air officers commanding, fighter groups, to dispense with the establishment of these balloon officers on the grounds that their duties could be combined with those of other specialist officers, but Air Marshal Gossage was strongly of the opinion, based on experience, that the posts should be filled by officers with practical balloon experience and, who, in addition, enjoyed the personal confidence of the commanders of the barrages they controlled. The suggestion was therefore withdrawn.

/Superficially,

Superficially, there was much to recommend the amalgamation of duties in these cases where there was little or nothing to do during spells of inaction, but, with the duties of the balloon officers taken over by the air raid warnings officers as suggested, there was the very real fear that balloon operational instructions would receive secondary attention in the event of emergency. Since the whole revised policy of operating balloon barrages turned on the immediate passing of flying instructions, the possible delay of even a minute could not be countenanced.

Warning Devices for Friendly Aircraft - "Squeakers".(1)

S.5504 Encl.1A. 14/6/40.

At the same time as the policy of imposing controls on balloon flying for the protection of friendly aircraft was being formulated, the Royal Aircraft Establishment, at the urgent instigation of the Air Officer Commanding-in-Chief, Bomber Command, was investigating the possibilities of warning aircraft by radio of the proximity of balloon barrages.

ibid. Encl.2A 11/7/40.

Within a month the Establishment had produced a solution that ultimately proved successful. A small transmitter (called a Squeaker) was evolved which gave a wailing note somewhat similar to an air raid siren, and one of its characteristics was that, while the minimum radius of transmission was some $8\frac{1}{2}$ miles, beyond that distance it could not be picked up by the equipment then installed in bomber aircraft (radio receivers type TR9).

ibid. Encls.4A. 3/8/40 81B. 2/3/41

The transmitter was tried out successfully in August, 1940, but mass production was held up by modifications and bottlenecks in the manufacture of components and barrages were not fully equipped with transmitters until the summer of 1941.

ibid. Encl.50A 15/10/40

The first instructions for the operationa of Squeakers laid down that transmitters would be switched on "during blackout hours and at all times except when visibility is greater than 5 miles, in the opinion of the Barrage Commander. In cases of doubt the set should be switched on."

ibid. Encl.86A. 12/6/41.

These instructions were followed by an Air Ministry signal that Squeakers were to operate at all times, both day or night, when balloons were flying.

ibid. Encl.106A. 29/7/41.

The next order was less simple. Squeakers were to operate (i) from sunset to sunrise, (ii) when local visibility during daylight fell below 4 miles, (iii) when balloons were flying in cloud.

ibid. Encl.157B. 18/7/42.

The final instruction was that Squeakers were to be in permanent operation regardless of the operational state of the balloons, so that at all times aircraft within a radius of $8\frac{1}{2}$ miles might be aware of their proximity. This did not apply to mobile barrages whose Squeakers were only to be switched on when the balloons were flying.

S.5504 Encl.214B. 1/6/43.

The responsibility for the control and close supervision of Squeakers was placed on barrage control, and very full instructions were issued. If any instrument became unserviceable, and remained so for more than two hours, no spare set being available, a signal had to be forwarded via the group operations room and Balloon Command to the Air Ministry, so that navigational warning of its unserviceability could be sent out to all flying units.

/Flying of Balloons etc.

(1) For further information on Squeakers see pp. 493-497.

Flying of Balloons in Adverse Weather

Balloon Cmd. ASI's Pt. 1 Ops. Serial No. 19. 22/5/40.

To safeguard a target as much as possible while at the same time trying to conserve balloons, it was decided early in 1940 to divide barrages into four categories, three being expressed as percentages of the total number of balloons:-

Category X		30%
Category Y	A further	20%
Category Z	A further	20%

ibid. Serial 118 16.12.42.

As the war continued the categories were reduced; category 1 corresponded to category X and represented 30% of the barrage; category 2 corresponded with categories Y and Z and represented a further 40% of the barrage; category 3 represented the remainder of the barrage.

It was always a proviso, however, that not less than sixteen balloons would ever be flown as a category in any barrage, so that in small barrages the category percentages had to be adjusted, or ignored altogether. Thus, a barrage of twenty balloons flew sixteen in category X (later, category 1) and the remaining four under either of the other categories (later category 2), while a barrage of sixteen balloons was not concerned with categories.

Balloon Command Air Staff Instructions specified the category or categories which would fly under various weather conditions. For example, under very thundery conditions, or in high winds it was directed that category X would fly on a dangerous plot; if the balloons in this category were mostly destroyed by lightning or carried away by wind, there would still be the remainder of the barrage available for immediate protection.(1)

Tactical Use of Balloons versus Fighters

AHB/IIH/240/4/142 ~~FO/S.21060~~ Encl. 2B. 1/9/40.

With the opening of the Battle of Britain came determined attacks on balloons by enemy fighters, notably at Dover,(2) and losses were sufficiently serious immediately to provoke tactics formulated essentially to protect the balloons and incidentally to destroy the attackers. The tactics were gratifyingly successful at Dover on 1st September, 1940, when, by enticing the enemy within range of the light anti-aircraft guns, they were largely instrumental in bringing about the destruction of three fighters for the loss of only two balloons. As a result, the following operational instructions were given to the coastal barrages at Hull, Harwich, Thames, Dover, Portsmouth, Southampton, Plymouth and Falmouth, which were considered particularly vulnerable to fighter attack:-

> "At all times when balloons are flown, 50% of the barrage is to be flown from 2,500 feet staggered down to 1,500 feet (referred to below as "A" balloons). The remaining 50% (referred to below as "B" balloons) will be flown at 500 feet or as near to this height as existing weather conditions permit.

/In the

(1) See Appendix "N". Balloon Command A.S.I.'s Part 1 Ops. Serial No. 118.

(2) See page 355.

In the event of an attack by hostile fighter aircraft. "A" balloons will be hauled down as quickly as possible to the height of the "B" balloons thus enabling full advantage to be taken of the protective barrage which can be provided by all A.A. guns, including light automatics.

In the event of a bombing attack taking place either following or without a fighter attack, "A" balloons will be raised to ruling operational height and staggered, while "B" balloons will be staggered from 2,500 feet down to 1,500 feet.

These instructions will apply during the hours of daylight and at night if it is considered that visibility is such that balloons could easily be seen by the attacking aircraft. When cloud conditions are such that the balloons could with some certainty be well hidden in them, these instructions will not apply, but normal operational practice will be adopted.

The purpose of these operational orders is to ensure that a proportion of these barrages is always available to counter a bombing attack following a fighter attack and it is therefore obvious that care must be used in selecting the sites of the "A" and "B" balloons so that if all the "A" balloons are shot down, the "B" balloons will still provide a barrage the pattern of which would provide the maximum protection of the Vulnerable Points.

Close liaison with the local A.A. Commander will be necessary in every case, in order to ensure the co-operation of the gun barrage."

AHB/IIH/240/4/142
~~PG/S21060~~
Encls.2A & 3A.
4/9/40.
ibid.
Encl.9A.
8/9/40.

The day of the fighter-bomber had not arrived, or the immediate protest of the Admiralty that these tactics exposed the base and anchorage at Harwich to bombing might have carried more weight. As it was, however, the Air Officer Commanding-in-Chief, Fighter Command, considered that the tactics should be given a trial unless good reasons to the contrary were forthcoming. A signal was therefore sent to the Admiralty on the 11th September, pointing out that these tactics were only adopted when the balloons were attacked by fighters, to ensure that balloon protection would remain as far as possible available to counter bombers.

Target Indication.

Balloon Cmd. ASI's. Pt.1. Ser.No.123 23/3/41.

One of the most difficult operational problems which faced Balloon Command was that of giving away a position, or target indication as it was called, by flying balloons above the tops of clouds. Air Staff Instructions therefore laid down that, when the base of the clouds was less than the maximum operational height of a barrage, the balloons would be flown just in the cloud base, thereby achieving the ideal conditions of an invisible aerial stockade. But cloud conditions differ constantly, both in extent and depth, and in practice it was not found feasible to obey precept and continually vary balloon height to correspond with cloud base. It was not surprising, therefore, that there were many complaints from the operational commands of balloons flying in full sunshine above a cloud mass which completely obscured the ground. Fighter Command even intercepted a radio message from an enemy aircraft, reporting on the weather in the Brentford area, and stating that balloons were visible above the first cloud layer.

AHB/IID/34/4/31
~~KRS/S54741~~
Encl.25B
11/2/41.

/The question

The question was referred to officially in a letter from the Director of Home Operations to the Air Officer Commanding-in-Chief, Fighter Command, in December, 1939. He stated that it had been found difficult to judge from the ground the height at which balloons should be flown, or, indeed, whether they should be flown at all under certain foggy or cloudy conditions. Balloons protruding above the clouds acted as excellent guides to enemy aircraft, both as a check on navigation and as an indication of a vulnerable point below.

Pending the perfection of cloud indicator instruments or other means of determining cloud height, it was therefore arranged that barrages should establish liaison with nearby aerodromes to enlist the aid of pilots in this direction. This, however, did not prove very successful, as it often happened that, when barrage commanders required information, bad visibility had cancelled all flying.

AHB/III/240/4/139
~~FO/S23547~~
Encl.50
20/3/41

The Problems of Haze

It was not only fog and cloud that caused trouble, as the following letter from the officer commanding, Fighter Interception Unit, Ford, illustrates well:-

"..... it is considered that there have been many recent cases when the flying of these balloons has revealed the proximity of the target they are designed to protect.

On several occasions during the recent hazy weather it has been almost impossible to see the ground when flying above the haze; occasionally it has been possible to see the ground almost vertically below the aircraft. On 15th March, 1941, at about 17.30 hours, there was a thick haze up to 3,500 feet, and, when it was possible to see the ground at all from that height, the maximum visibility down sun was about half a mile. This applied to the general area Hendon, Northolt, Guildford, Horsham, and may have extended beyond. Brooklands Balloon Barrage was flying in bright sunlight at about 5,000 feet and the Langley barrage was the same. It is agreed that Royal Air Force pilots know the position of these barrages, but it is suggested that the enemy almost certainly have the same information, and could have used them to verify their position when it was impossible to do so by visual observation of the ground.

Between 18.30 and 19.30 hours on 19th March, 1941, there was a thick layer of haze with its top at 5,000 feet over the general area Christchurch, Portsmouth, Ford, Horsham, Boscombe Down. When looking up sun it was impossible to see the ground, and when looking down sun it was occasionally possible to get glimpses of light objects such as light coloured arterial roads. At this time the Eastleigh and Portsmouth balloon barrage was visible 1,000 feet above the haze.

It is suggested that, on both occasions already mentioned, Observers on the ground saw blue sky above them and were not aware of the thickness of the haze and outstanding appearance of their balloons above it. This suggestion is backed up by the fact that the air crews, who made the observation, found visibility much worse than they had expected from observations made on the ground at Ford prior to these flights.

/It is suggested

It is suggested that the decision to fly balloon barrages should not be based on the visibility as it appears to a ground observer. On each of the above-mentioned occasions the balloons would have been more effective had they been flown just below the level top of the haze."

Cloud Indicators.

S.3852
Encl.34A
21/1/42.

Balloon
Command
A.S.I.'s.
Pt.1.(Ops.)
Serial No.121
3/5/43.

It was not until January, 1942 that satisfactory trials had been carried out with a cloud indicator instrument, and shortly afterwards barrages were equipped with this apparatus, which worked well in cloud and fog but not in haze. Air Staff Instructions were issued governing its use, ascents being made under conditions of six-tenths or more cloud at seven stated intervals during the twenty-four hours, or more often if required by barrage control; ascents, however, were not made in hazardous weather. Barrage commanders determined the ruling operational height on the strength of the data supplied by the apparatus.

Cloud indicator balloons were subject to normal control but, if under control, were allowed to make ascents by special permission of the controlling authority. When flying for this purpose their cables were not armed, though at all other times they conformed to normal operational balloon practice.

Regularised Control

Balloon
Command
A.S.I.'s
Pt.1.(Ops.)

By the end of 1942 the general course of action had become constant, and it is interesting to note briefly the change in outlook and method of approach that three years of war experience had brought about.

In the first place, the accent on policy, as was only to be expected in the light of experience, had become particular rather than general, the object being, in the words of the preamble to the appropriate section of Air Staff Instructions, Part 1 (Operations) -

"to provide the maximum balloon protection possible commensurate with the prevailing weather conditions immediately but not until an air attack threatens a barrage area."

In the second place the general directions given to the barrage commander showed that the problems facing him were recognised and that he was therefore accorded a broad authority. After making the rather obvious point that fewer balloons should be hazarded in bad than in good conditions, it was laid down as a guiding principle that, when an attack threatened or developed on a barrage area, the primary consideration governing the action to be taken was the safety of the targets, the loss of balloons being of lesser importance. But if weather conditions were so bad, in the opinion of the barrage commander, as to make it certain that an order to fly would involve -

"balloon casualties so great as to nullify the value of balloon protection, he was authorised to keep the whole barrage grounded."

/In the third

In the third place, it was determined that -

"when a barrage is not directly threatened balloons are grounded, or kept at a reduced height where they will provide as little potential danger as possible to friendly aircraft."

Balloon Command SI's Pt. 1. Ser. No. 116. 16/12/42.

The changes affected the operational chain of command, the links in which were now:-

Fighter Command
I
Fighter Groups
I
Barrage Commanders
I
Squadrons
I
Flights
I
Sites

Balloon Command was now at its zenith, and declined in importance and prominence only as the German Air Force lost its ability to wage offensive operations. But the balloon flying policy remained fundamentally the same during the remainder of the war in Europe.

/SECTION 8.

SECTION 8

BALLOON BARRAGES IN IRELAND

Belfast

S.5474
Encl.1A.

Early in July, 1940, the Army Council informed the Air Council that they had received a communication from Headquarters, Northern Ireland District, requesting particulars and plans for the installation of a balloon barrage in Northern Ireland. The Air Council replied that should such a barrage become necessary, the Air Ministry would make all arrangements.

The subject was again raised on the 8th August, when the Commander-in-Chief, Western Approaches, (Admiral Sir M. Dunbar-Nasmith) informed the Admiralty that -

> "during my visit to Belfast on 7th August, the lack of A.A. defence of the port generally was brought to my notice by all concerned and was particularly keenly felt by the manager of the Shipyard who spoke most strongly on the subject. Apart from the definite requirement from the military aspect, I feel that any delay would be a severe test of the loyalty of those splendid Northern Irishmen who are playing such an important part in the national war effort."

Admiral Dunbar-Nasmith, therefore, strongly recommended that adequate anti-aircraft defence, including a balloon barrage, should be allocated to Belfast as soon as practicable.

D.C.O.S.(A.A.)
Sub-Committee
18th Meeting,
10/8/40.

Two days later the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee approved a barrage of forty balloons for Belfast. This was to consist of thirty-two land and eight waterborne balloons to be deployed during the third week in September. A further ten Very Low Altitude balloons were to be flown at a later date to prevent minelaying in Belfast Lough. A new squadron, No.968 Squadron, would be formed within No.34 (Balloon) Group, for service in Northern Ireland.

S.5474
Encl.11A.

Ibid.
Encl.12A.

The Air Officer Commanding, Royal Air Force in Northern Ireland, had also become concerned at the lack of balloons at Belfast and on the 16th August urged the Air Ministry to ensure that the barrage became operational by 15th September, at the latest. His plea was not in vain, as the balloons, or at any rate, the land-based balloons, were flying and operational at 08.00 hours on the day suggested. Meanwhile, in order to bring No.968 Squadron into line with other units in Northern Ireland the Air Ministry decided it should be controlled and administered as follows:-

A48/1H/240/4/143
~~FC/S.21074~~
Encl.9A.

(a) Administration and discipline

Headquarters, Royal Air Force in Northern Ireland.

(b) Technical administration

Headquarters, Balloon Command, through Headquarters, No.34 (Balloon) Group

(c) Operational Control

(i) Under the prevailing conditions (i.e. no hostilities in Northern Ireland or Eire) by Headquarters, Fighter Command through No.13 (Fighter) Group, via Sector Station, Aldergrove.

/(ii) Under

(ii) Under certain eventualities (i.e. in the event of a German invasion of Northern Ireland or Eire) by Headquarters, Royal Air Force in Northern Ireland.

ibid. Encl. 15A. The Air Officer Commanding-in-Chief, Fighter Command, however, decided under the prevailing conditions to invest operational control in Headquarters, Royal Air Force in Northern Ireland.

AHB/II H/240/4/143 ~~FC/S.24074~~ Encl. 22A By October, the Admiralty had, after some difficulty, managed to provide craft for the waterborne balloons, and the Air Officer Commanding, Royal Air Force in Northern Ireland, issued instruction, on the 20th October, for the balloons to be flown from then forthwith. This instruction was immediately countermanded by the Air Officer Commanding-in-Chief, Fighter Command, who had neither approved the siting plan nor requested the Air Ministry to send out a warning to all flying units that new balloons were about to become operational. Although this action was perfectly correct it was unfortunate for on the night of the 24th/25th enemy aircraft heavily mined Belfast Lough.

ibid. Encl. 26A The Air Officer Commanding, Royal Air Force in Northern Ireland, promptly signalled this information to Headquarters, Fighter Command, adding:-

> "Had 968 Squadron not been ordered by 34 Group to deflate waterborne balloons already flying mining aircraft would have been obstructed and probably destroyed and port remained open. Previous experience shows that enemy tends to mine Lough spasmodically but intensively. May therefore expect similar action for some nights to come. Deplorable if this is allowed to happen uninterruptedly while waiting for permission to take suitable action to counteract it."

ibid. Encl. 28A But Headquarters, Fighter Command, were still unable to give the necessary permission for unrestricted flying owing to the fact that the warning of the presence of balloons had not yet reached all flying units. Nevertheless, they compromised and informed the Air Officer Commanding that he could fly the waterborne balloons to a height of 1,000 feet forthwith.

Londonderry

AHB/II H/240/4/144 ~~FC/S.24192~~ Encl. 1A Meanwhile, a second balloon barrage had been established in Northern Ireland. On the 2nd September, 1940, the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee had approved the provision of a balloon barrage to protect the naval base at Londonderry. The balloons were to be provided by the detachment of units from existing barrages at the discretion of the Air Officer Commanding-in-Chief, Fighter Command. Air Marshal Dowding thereupon decided to move the barrage from the Kyle of Lochalsh. No.920 Squadron, comprising sixteen balloons, was therefore transferred to Londonderry and became operational with effect from the 8th October, 1940.

ibid. Encl. 26A

ibid. Encl. 35A In July, 1941, the Chiefs of Staff (Anti-Aircraft) Shadow Sub-Committee invited the Air Ministry to consider the provision of an additional twenty-four balloons, in order to provide protection for a proposed new naval base at Lisalally near Londonderry. The preliminary reconnaissance report indicated that sixteen balloons would be required at Lisalally, but the Air Officer Commanding, Balloon Command, strongly recommended that a further eight balloons should be used in the Londonderry barrage

ibid. Encl. 38A

/"In order

"In order to strengthen the existing protection in view of the greatly increased activity which is taking place there and which includes the construction of new docks."

ibid. Encl.58A. The siting of sixteen balloons at Lisalally was approved and the barrage became operational on the 18th July.

ibid. Encl.57A. The additional eight balloons for Londonderry were approved by the Air Ministry on the 26th July and became operational four days later, the establishment of No.920 Squadron having been increased to forty balloons to cover both Londonderry and Lisalally.

Proposed Balloon Barrage for Eire.

S.7464 Encl.1A. On the 17th August, 1940, it was agreed by the Chiefs of Staff Committee to instruct the sub-committee on the Allocation of Active Air Defences to draw up an estimate of the defence requirements of Eire should that country be invaded by Germany.

In due course, therefore, the Chiefs of Staff (Anti-Aircraft) Sub-Committee submitted their recommendations which stated, inter-alia, that in addition to the barrages at Belfast and Londonderry, some sixty balloons would be required for the Shannon-Foynes area, while it might be advisable to provide a barrage of forty balloons for Dublin.(1)

ibid. Encl.20B The Air Officer Commanding, Balloon Command, was instructed to make arrangements to meet these commitments should they become necessary. He proposed to do so by setting up three squadrons on a "Rover" basis. These would be formed as follows:-

No.30 (Balloon) Group	1 Rover squadron 3 flights - 30 balloons
No.32 (Balloon) Group	1 Rover squadron 3 flights - 30 balloons
No.33 (Balloon) Group	1 Rover squadron 4 flights - 40 balloons

Officers and airmen were to be selected for the squadrons and, if necessary, to be held surplus to the establishment ceiling of the groups. No equipment was to be withdrawn from sites, and no arrangements were to be made at present with regard to the supply of hydrogen.

S.71548 Encl.47A. Various other plans for the proposed barrages were put forward during 1941, including the formation of a balloon centre in Eire. But as the strength of the German Air Force ebbed away, the interest in possible air defences for Eire lessened, until, finally, on 13th January, 1942, the Air Ministry informed the Air Officer Commanding, Balloon Command, that the scheme was cancelled.

/SECTION 9

(1) The Chiefs of Staff approved these recommendations at their 409th meeting on the 29th November, 1940.

SECTION 9

ADDITIONAL BALLOON BARRAGES

The establishment of German airfields in the conquered provinces of north-west France brought the western and south-western ports of Great Britain within the orbit of enemy bombing and it became necessary to provide defences for areas hitherto considered more or less immune from enemy attack. With this situation in view, the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee at its meeting on the 10th August, 1940, approved new balloon barrages recommended by the Air Staff at:-

D.C.O.S.(A.A.) 18th Meeting 10/8/40.

Falmouth	24 balloons
Ardeer	48 balloons (including eight waterborne)
Newport	40 balloons
Milford Haven	48 balloons
Belfast	40 balloons

Immediate steps were taken to provide these barrages and they all became operational by the middle of September, 1940.

Falmouth.

The Air Officer Commanding, Balloon Command, had been aware for some time that a balloon barrage was likely to be established at Falmouth, the first of the new barrages to be implemented, and in anticipation, in July 1940, instructed his staff to carry out a reconnaissance of the port. The points to be protected were firstly, the dockyard, used for the maintenance and repair of Admiralty vessels, and secondly, petrol storage tanks belonging for the most part to the Air Ministry. The number of balloons to be deployed had been provisionally fixed at sixteen and the reconnaissance was carried out with that number of sites in mind, but the resultant report emphasized that twenty-four balloons would be required. At present, however, only sixteen sites had been selected. These comprised eleven land sites and five waterborne. The number of waterborne sites was restricted to a minimum owing to the necessity for keeping the swept harbour channels as clear of craft as possible and because of the rough weather experienced south of the Falmouth peninsula. Land siting was complicated by the high cliffs rising from the sea which made it difficult to find sites near the shore.

S.6471 Encl.1A.

AHB/I.D/34/4/3A
~~KBS/8.50305/~~
Ops.Pt.1 Encl.1A 1/8/40. ibid. Encl.14A.

With the object of saving manpower, Balloon Command proposed to fly the Falmouth waterborne balloons from buoys instead of vessels. But this proposal failed to find favour with the Naval authorities. The Commander-in-Chief, Western Approaches, informed the Air Ministry that experience gained at Plymouth had indicated that balloons which could not be close-hauled were liable to suffer heavy casualties and could act as target indicators when clouds were low. He considered also that the ceiling of balloons flying from buoys (1) was too low to be effective and that craft to service buoys would not be available when the channel convoy was in harbour.

/In addition

(1) The maximum altitude of balloons flying from buoys was 2,500 - 3,000 feet.

ibid.
Encl.15A
5/8/40

In addition, flying boats might require to use the harbour approaches at short notice. The Air Officer Commanding, Balloon Command, replied to these criticisms by retorting that waterborne balloons, whether on buoys or vessels, could not escape the consequences of storms by being bedded down and that the difference in the height to which they could be flown was low enough to be immaterial. Neither would it be necessary to service balloons during the short periods the channel convoy was in harbour. However, the controversy was short-lived as No.15 (Coastal) Group required an emergency control over the Falmouth Barrage in order that flying boats could operate; flying from buoys thereupon ceased to be a practical proposition.

ibid.
Encl.21A
11/8/40.

ibid.
Encl.26B
9/8/40.

Meanwhile, preparations were in hand for deployment and a further reconnaissance was carried out to site the additional eight balloons. The squadron would now consist of three flights of eight balloons each, comprising sixteen land sites and eight waterborne sites. No.959 Squadron, a mobile unit, was ordered to move from Cardington on the 14th August for deployment at Falmouth under No.13 Balloon Centre, with instructions to fly balloons from land sites on 19th August. The deployment of waterborne balloons was delayed owing to the lack of craft. The squadron arrived at Falmouth on the evening of 16th August. Preparations for flying balloons were made but it was found impossible to comply with the order to fly all land-sited balloons on the 19th August owing to deficiencies of equipment. However, these were remedied and fifteen out of the sixteen land-sited balloons were flying by midnight and on the 22nd August.

ibid.
Encl.33A
ibid.
Encl.37A
17/8/40.
F.540.
AHB/II/D/34/4/3(A)
~~KBC/S.50305/Ops.~~
Encl.39A.
19/8/40.

AHB/II/H/240/4/141
~~FC/S.20976~~
Encl.1A
28/8/40.

Ardeer.

In accordance with the decision of the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee, Balloon Command made preparations to fly balloons at Ardeer in Ayrshire in August, 1940. The balloons were sited to protect the works of Imperial Chemical Industries and the Royal Ordinance factory at Irvine. It was found impracticable to use waterborne balloons as the craft would be lying off a lee shore making maintenance hazardous, while land balloons had to be sited with care to avoid the danger of the descending on the explosive works. Twenty-four balloons, half the complete barrage, were to be deployed. No.967 Squadron was formed at No.18 Balloon Centre (Bishopbriggs) on the 24th August, and proceeded to Ardeer four days later, and twenty-four balloons were inflated by the evening of 1st September. A number of balloons had subsequently to be re-sited as they were on the flying route between the coast and Abbotsinch.

F.540

AHB/II/H/240/4/141
~~FC/S.20976~~
Encl.13A.
8/9/40.

ibid.
Encl.30B.
27/1/41.

When the Air Officer Commanding, Balloon Command, was considering strengthening certain balloon barrages in January, 1941, he proposed to withdraw sixteen L.Z. balloons from Ardeer and substitute for them eight Mark VI balloons. In explanation, he pointed out to Fighter Command that only half the barrage had ever been authorised to fly at Ardeer and taking into consideration the relative importance of other places he did not consider complete deployment was justified as the balloons released could be used with greater advantage elsewhere. The operational strength of the Ardeer barrage remained at twenty-four balloons during the whole period of deployment, though an increase in establishment of eight balloons was approved by the Deputy Chiefs of Staff (Anti-Aircraft Sub-Committee in April, 1941. In February, 1942, the same sub-committee decided upon the abolition of the Ardeer barrage, and No.967 Squadron was disbanded in March, 1942.

ibid.
Encl.30A.
31/3/41.

ibid.
Encl.35A.
5/10/41.

ibid.
Encl.44A.
16/2/42.

/Newport (Monmouth)

Newport (Monmouth)

F.540

The balloon barrage at Newport (Monmouth), authorised by the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee at its meeting on 10th August, 1940, was planned to protect docks on the River Usk, marshalling yards, iron works, munition works, aluminium works, and the main road bridge over the river. It was to consist of 40 balloons, a substantial increase from the twenty-four first proposed. A reconnaissance was carried out to select sites in July, 1940, as Balloon Command had been informed that a barrage would shortly be required there.

AHB/III/34/5/4
~~KBC/S.5048/Org.~~
Encl.4A.
12/8/40.

The barrage was to be manned by a new squadron, to be formed by No.33 Group. This was the first time that a group had been called upon to supply a new squadron from within its own resources for deployment in another part of the country. Flights were assembled at balloon centres at Sheffield, Newcastle and Hull, and left for Newport between the 26th and 28th August, winches being collected at Cardington. Fifteen balloons were inflated and flying by the 31st August, the remaining sites became operational during the following week. Within a fortnight of deployment No.966 Squadron was fortunate enough to bring down a Heinkel 111 which struck the balloon cable on Site 10. (1)

ibid.
Encl.24A.
27/8/40.
F.540.
3/8/40.

Milford Haven.

F.540.
31G/S.692.
18/8/40.

In August, 1940, instructions were given for the formation of No.962 Squadron at No.5 Balloon Centre for deployment at Milford Haven on 1st September, in accordance with the decision of the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee at its meeting on the 10th August, 1940. The barrage was intended to protect the fleet anchorage and forty-eight sites had been selected, but only twenty-four were to be deployed, nine waterborne and fifteen land sites. Two flights were to operate to the north of Milford Haven and one to the south. As barges were not yet available additional land sites were to be used.

ibid.
28/8/40.
ibid. 1/9/40.

The main detachment of No.962 Squadron arrived at Milford Haven on the 28th August, and twenty-four balloons were flying by the evening of the 1st September.

S.6464
Encl.4A
21/9/40.

It was soon found that the barrage interfered seriously with the operation of flying boats in the Haven and that, as it had only been designed to protect the fleet anchorage, it did not cover other objectives in the area. The most important of these were the naval oil tanks at Llanreath and Llanion near Pembroke Dock. In order to reconcile the conflicting interests of flying boats and balloons, a

ibid.
Encl.6A.
30/9/40.

conference was held on the 25th September, at which it was decided to re-site the balloons in such a manner as not to interfere with flying and at the same time to protect vulnerable points. It was proposed to site the twenty-four balloons round Llanion, Llanreath and Pembroke Dock, and not to attempt, at that time, the protection of the fleet anchorage or convoy assembly anchorage. The new siting meant that sixteen balloons would be flown on the south side of the Haven and eight on the north, with the provision that the balloons on the north side might be withdrawn when

ibid. Encl.8A.
3/10/40. F.540
26/10/40.

light anti-aircraft guns were available. These proposals were approved by the Air Ministry and deployment to the new sites completed by the 26th October.

/At its

(1) See Section 29 "Collisions: Aircraft and Balloon cables."

C.O.S.(A.A.) CTTEE. 23rd Meeting 22/11/40.

At its 23rd meeting on 22nd November, 1940, the Chiefs of Staff (Anti-Aircraft) Committee considered a letter from the flag officer-in-charge of Milford Haven in which he pointed out that since the removal of the balloon barrage from the area of the fleet anchorage in Milford Haven to the vicinity of Pembroke Dock, enemy attacks on the anchorage had occurred. Under these circumstances the Commander-in-Chief, Western Approaches, strongly recommended that balloons should be flown to prevent enemy minelaying in the harbour and its approaches, and suggested that if the local Royal Air Force station was given control over the balloons the operation of flying boats would not be hampered. The Air Officer Commanding-in-Chief, Fighter Command, agreed, that if the balloons were sited at the entrance to the channel and placed under the control of Coastal Command there need be no interference with flying. The committee decided that the Air Ministry should be requested to examine the possibility of providing a balloon barrage to protect the convoy anchorage and the outer channels of the Haven. The implications of this decision were discussed on the 28th December, and it was agreed to provide an anti-minelaying Mark VI barrage based on Milford Haven for the outer channels. This would be under the control of Royal Air Force Station, Pembroke Dock, but no barrage was to be provided for the convoy anchorage as the operation of flying boats and balloons in this area were considered incompatible. However, the Mark VI anti-minelaying barrage was never brought into use as the policy governing their introduction was changed in 1941, and the barrage continued to fly twenty-four balloons all sited in the neighbourhood of Pembroke Dock.

South Wales

Form 540. No.935 Sq. 14/1/40.

At the beginning of the war the only balloons in Wales were those at Cardiff. Here No.935 Squadron was stationed with an establishment of sixteen balloons, but on the 3rd September, 1939, only four were flying. This total was subsequently increased but never exceeded eleven during the first winter of the war, and was reduced again to four on the 20th January, 1940, the remainder being deflated in accordance with the conservation policy. When No.935 Squadron was ordered overseas (1) its place was taken in March, 1940, by No.953 Squadron, which had been formed at No.14 Balloon Centre.

11/3/40. AHB/IID/34/4/29(A). ~~KBC/S.53252/Ops.~~ Encl.2B. 19/3/40.

During the same month the Air Ministry instructed the Air Officer Commanding-in-Chief, Fighter Command, to make arrangements to fly balloons at Swansea and Port Talbot as authorised by the Committee of Imperial Defence at its 331st meeting. A reconnaissance of these areas was carried out by Headquarters, No.32 Group and eight sites selected, four in the Swansea district and the remainder at Port Talbot. The object of these few balloons was to give token protection to oil refineries and factories at each port. The reconnaissance report emphasized the operational and administrative difficulties that would result from dividing a single flight of balloons between two areas twelve miles apart. Instructions were given however, to No.953 Squadron to administer the barrage at Swansea and Port Talbot as a detached flight, without any addition to its existing establishment, thereby reducing the number of balloons at Cardiff to eight. Balloon Command anticipated being able to fly from the new sites on the 7th June, but, owing to shortage of equipment, deployment was postponed until the following month when the sites at Swansea and Cardiff became operational on the 8th and 20th July respectively.

ibid. Encl.9A.

AHB/IID/34/5/21 ~~KBC/S.58921/Org.~~ Encl.31A. 25/5/40.

AHB/IID/34/4/29(A) KBC/S.53252/Ops. Encl.32A. 4/6/40. Form 540. No.953 Sq.

(1) It was intended that No.935 Squadron should be dispatched to Norway. When this commitment was cancelled, No.935 Squadron was deployed at Bristol.

~~KBC/S. 021 Org.~~
Encl.44C.
3/6/40.

Meanwhile, in June, the Air Officer Commanding, Balloon Command, had expressed his misgiving with regard to the meagre balloon protection afforded to South Wales; in view of the German occupation of the Channel ports and the consequent diversion of British shipping to west coast ports. He asked that the barrage at Cardiff be increased by one flight, for the establishment of a flight to protect Barry Dock, and also for an additional flight at Swansea. These increases received the approval of the Air Ministry and the sanction of the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee at its 17th meeting held on the 9th July, 1940. By the end of that month, No.953 Squadron had been reorganised as a five-flight squadron controlling forty balloons deployed at Cardiff, Barry Dock, Port Talbot and Swansea.

ibid.
Encl.44A.
24/6/40.
D.C.O.S.(A.A.)
Sub-Committee
Minutes.

AHB/IID/34/4/29A
~~KBC/S53252/Ops.~~
Encl.40A.
8/8/40.

The war situation in the summer of 1940 made this increase protection appear meagre, and No.32 Group was instructed to extend the Swansea barrage to cover the Llandarcy oil refineries which lay to the east of the town. This extension involved the deployment of a further twenty-four balloons, sixteen of which were sited to cover the oil refineries.

ibid.
Encl.41A.
11/8/40.

As a barrage of these proportions could no longer be maintained as a detachment of the Cardiff squadron, it was decided that No.958 Squadron, a mobile squadron at Cardington, should be moved to Swansea to control the thirty-two sites in that area together with three of the waterborne balloons forming part of the Bristol Channel anti-minelaying barrage.

Form 540
No.933 Sqdn.
13/8/40.

On the 13th August, No.958 Squadron moved to Swansea from Cardington and took over the sites already deployed. The additional balloons, bringing the total to thirty-two in the Swansea area, were inflated and flying by the 26th August. The balloons at Port Talbot also ceased to form part of the Cardiff squadron and became an independent unit known as No.965 Squadron. Two days later eight more balloons were added so that the Port Talbot barrage eventually consisted of sixteen balloons in two flights, each.

Form
No.969 Sqdn.
16/8/40.
Form 540
No.969 Sqdn.
29/8/40.
Form 540.
No.969 Sqdn.
4/9/40.

At about the same time No.969 Squadron was instructed to take over control of the balloons protecting Barry Dock which had hitherto formed part of No.953 Squadron. No.969 Squadron moved to Barry on the 29th August, and two days later was flying sixteen balloons, including an additional flight of eight balloons.

D.C.O.S.(A.A.)
Sub-Committee
Minutes.
18th Meeting,
10/8/40.
~~KBC/S58921/Org.~~*
Encl.74A.
13/8/40

Form 540
No.953 Sqdn.
1/9/40.

The meeting of the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee held on the 10th August, 1940, which authorised the extensions to the barrages at Swansea, Port Talbot, and Barry, also agreed to increase the Cardiff barrage by sixteen balloons. Balloon Command accordingly gave instructions to No.32 Group for No.953 Squadron to be re-organised to fly thirty-two land-sited balloons and to control seven waterborne balloons, part of the Bristol Channel anti-minelaying barrage. The additional balloons were flying at Cardiff on the 1st September, 1940.

* AHB/IID/34/5/21

/A heavy

D.C.O.S.(A.A.) Sub-Committee Minutes. 20th Meeting, 2/9/40.

A heavy air attack on Swansea on the 1st September, drew attention to the need for protecting the lock gates of the harbour, at that time very crowded with vessels. This matter was discussed at the meeting of the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee held on the 2nd September, 1940, and re-deployment of the balloons flying at Swansea to cover those gates was recommended as a matter of the utmost urgency. The same meeting also agreed that as an alternative to light anti-aircraft guns, which were not available, the balloon barrages at Cardiff and Newport should be extended to protect the gates at those ports. Land-based balloons at Swansea were re-sited, but to give greater protection to the harbour it was found necessary to fly four of the balloons from buoys as the water was too shallow for craft. Similar action was taken at Cardiff where three balloons were transferred from land sites to buoys and a further balloon flown from Penarth Pier to protect the lock gates.

AHS/SD/34/4/29(A).
~~KBO/S.53252/Ops.~~
Encl. 74A.
2/9/40
ibid.
Encl. 81A.
25/9/40
~~KBO/S53252/Ops.~~
Encl. 77A.
6/9/40.
~~KBO/S53252/Org.~~
Encl. 81A.
27/9/40.

/SECTION 10

SECTION 10.

CO-OPERATION BETWEEN ANTI-AIRCRAFT AND BALLOON UNITS.

The first meeting of the Deputy Chiefs of Staff (Anti-Aircraft) Sub-Committee was held on the 27th October, 1939, to discuss the allocation of anti-aircraft gun, searchlight and balloon defences for vital points in the United Kingdom. Representatives of the Admiralty, the War Office and the Air Ministry were present.

AM/S.2933
Encl.11A.
4/12/39

Both the General Officer Commanding-in-Chief, Anti-Aircraft Command, and the Air Officer Commanding-in-Chief, Fighter Command, were of the opinion that they, or their representatives, should attend all meetings of the Sub-Committee, and a formal request to this effect was submitted to the Air Ministry on the 4th December, 1939 by the Air Officer Commanding-in-Chief, Fighter Command, and was agreed. Thus adequate representation of the operational forces employed in the defence of the United Kingdom against air attack was provided on the sub-committee, and close co-operation between the two Commands ensured.

Training Control of Balloon Barrages.

AHB/II/14/240/4/136
~~FC/S19345/Ops.~~2b
Encl.30A.

On the 24th April, 1940 Headquarters, Fighter Command requested that representatives from Anti-Aircraft and Balloon Commands and from three fighter Groups should attend a conference to discuss "training control" over balloon barrages throughout the country.

With this request some notes were circulated on the present conditions of "training control". In a previous letter it had been stated that such a control over barrages, with certain exceptions, had been decentralised to fighter groups in a restricted flying area and to local anti-aircraft defence commanders in a non-restricted flying area.

There were, therefore, no restrictions whatever against air co-operation for anti-aircraft and searchlight training over any balloon barrage area for which "training control" had been granted, and the authority exercising this control was empowered to close-haul or temporarily to reduce the flying height of balloons for such co-operation, at any time.

AHB/II/14/240/4/136
~~FC/S.19345~~
Encl.30D.

It was obvious, however, that balloons so controlled had a temporarily reduced defensive value, and that the difficulties which existed at that time in communications, tended to involve delay in warning local barrage commanders of approaching enemy raids. It was also a fact that air co-operation was of more value to the ground defences, if carried out at the greatest possible heights permitted by weather conditions; normally searchlight co-operation did not take place below 4,000 feet. Finally, over built-up areas, pilots were required to maintain sufficient height to carry out a forced landing in an emergency. These factors had to be kept constantly in mind by those authorities who exercised this control and discretion was needed so that balloons were not hauled down unnecessarily for all air co-operation.

/"Training

"Training Control" was not decentralised in night artillery zones, which covered certain fleet anchorages and estuaries, nor was the control granted to local authorities over balloons in the London night artillery zone or the Glasgow defended area. If such control was essential for any particular form of air co-operation, it could be obtained for specific periods, as required, from Headquarters, Fighter Command. Otherwise, when hauling down balloons was not involved, there were no restrictions against organised air co-operation by day or night over these areas, provided that the proposed programme was submitted to that Headquarters for prior approval.

Similarly, "training control" was not decentralised in the Tees defended area, where the balloons could not be hauled down without prior consent of Headquarters, Fighter Command. Provided that balloons did not need to be hauled down, other air co-operation by day was not restricted; by night, however, this was confined to three nights a week, and as, in the case of other coastal area training, no two adjacent searchlight company areas were to be illuminated simultaneously.

On receipt of a "yellow" Air Raid Warning, or on orders from the fighter group concerned, based on the tactical situation, balloons hauled down for under the control would be raised to operational height without delay.

At the meeting, it was decided that a standard procedure was required for notifying co-operation programmes to fighter groups, and for ensuring that the balloons concerned were flying at the desired height before the commencement of co-operation.

The Air Officer Commanding-in-Chief, Fighter Command discussing the notes of the meeting with the Air Officer Commanding, Balloon Command, stated that light anti-aircraft guns should no longer be located in areas defended by balloons and that all future heavy anti-aircraft gun and searchlight co-operation should be carried out above the operational height of balloons. Both bedding and close-hauling of balloons, therefore, were not required and "training control" became unnecessary.

AHB/II/H/240/4/136
~~FC/S.19315/Ops.~~
2b
Encl.46A.
21/5/40.

A letter was, therefore circulated to Anti-Aircraft and Balloon Commands and to Fighter Groups, informing them that the Commander-in-Chief had considered in detail the various views raised at the recent conference and in view of the altered war conditions, all "training control" of balloons was cancelled; that future air co-operation for searchlights and anti-aircraft guns within or adjacent to a balloon barrage was to be carried out above the balloons. In the few cases where light anti-aircraft guns were provided in an area defended by a balloon barrage, their training was to take place when the balloons were already grounded for technical or other reasons. Balloons were, however, not to be close-hauled specifically for the training of light anti-aircraft batteries.

Exercise in London Area with 1st Anti-Aircraft Division.

Authority was requested, at the beginning of October, 1940, from Headquarters Fighter Command for the close-hauling of balloons in the London barrage for an exercise in co-operation with the 1st Anti-Aircraft Division. The purpose of this exercise was to find out if the presence of the balloon cables in the air interfered with the target indicators of the guns.

/Headquarters

AHB/IIH/240/4/142
~~FC/S.21060/~~
Ops.2(a)
Encl.27A
5/10/40.

Headquarters, Fighter Command, granted permission for this exercise and said that this procedure might be continued nightly in future on request. Fighter Command Operation Instruction No.39 laid down that it was of the utmost importance that enemy aircraft should not observe the close-hauling of the balloons, and to obviate this the following procedure would be adopted:-

"(i) Balloons must not be hauled down until darkness makes it certain that the operation will not be seen.

(ii) Balloons must revert to operational height before daylight.

(iii) Balloons must not be hauled down on bright moonlight nights or on any other occasion when their absence might be noticed by the enemy. Balloon Command will be the ruling authority in these respects.

(iv) Balloons are to revert to operational height directly there is any indication that enemy aircraft are approaching the area at a height of five thousand feet or less."

The request for the balloons to be close hauled was to be initiated by the 1st Anti-Aircraft Division direct to Headquarters Balloon Command, the code to be used being "LONDON PART DULL".

Grounding of Balloons to facilitate Anti-Aircraft gunfire at night.

Later in October, 1940, the General Officer Commanding-in-Chief, (Lieut.General Sir Frederick Pile) Anti-Aircraft Command, requested the Air Officer Commanding-in-Chief, Fighter Command to give approval for fighter group commanders to authorise the close-hauling of balloons in any defended area within their command, in consultation with the local Anti-Aircraft division commander.

The reason for this request was that very considerable interference has been obtained from barrage balloons by G.I. stations operating in their neighbourhood. This interference took the form of a multitude of echoes of varying strength from the balloons and their cables appearing on the tube, which confused the echo from enemy aircraft. Owing to their intensity and varying volume of different bearings, it had been found impossible to determine an accurate range, which nullified any attempt to direct accurate anti-aircraft fire on to an unseen target.

The General Officer Commanding-in-Chief, suggested that the enemy would be unable to detect any weakness in the defence of a particular area through the close-hauling of balloons, provided such an operation was carried out after darkness, and that occasionally the balloons be flown at their normal operational heights.

/Although

Although the objections to this proposal were obvious, as it meant that balloons would never be flown at night, the Air Officer Commanding-in-Chief, Fighter Command (Air Chief Marshal Sir Hugh Dowding) felt that he must support the request because the additional accuracy imparted to the guns by the G.I. sets was an advantage we could not afford to forego. If there was any sign that the enemy had discovered the practice and was taking advantage of it by delivering low flying attacks, the balloon barrage could be raised again at short notice.

However, as the question might have political repercussions, through the inhabitants of a defended area discovering that the balloons were not being flown at night, and raising an agitation on the subject, he requested the Under-Secretary of State for Air to refer the matter to the War Cabinet with a note to the effect that he, personally, supported the proposal.

He pointed out that this procedure had been carried out in the Inner Artillery Zone for the past fortnight, with no repercussions, and that he had also given permission for a similar procedure in Birmingham.

The Air Officer Commanding, Balloon Command (Air Vice-Marshal O.T. Boyd) who had also received a copy of the letter from the General Officer Commanding-in-Chief, Anti-Aircraft Command, did not, however, agree with the proposal. In a letter to Headquarters, Fighter Command, the Air Officer Commanding said:-

ibid.
Encl.62A.

> "I am very disturbed at the state of affairs which is envisaged in this letter, and which virtually entails the grounding of barrage balloons at night in all gun-defended areas during air raids.
>
> The main purpose of the barrage is to force enemy aircraft to fly above 5,000 feet, because they cannot so effectively be engaged by anti-aircraft guns below this height. I consider that if the close-hauling of balloons at night is resorted to as suggested, it will very quickly become known to the enemy, who will take advantage of it to make low flying attacks on targets. This will undoubtedly have a serious effect on the morale of the population in those areas, and in particular, on civilians engaged in work in essential war industries, at aircraft factories and the like.
>
> To raise balloons if enemy aircraft are approaching at low altitude is not satisfactory in practice. The height of the approaching enemy aircraft is not obtainable in a number of cases and, when it is given, the time remaining rarely permits of the message reaching balloon sites and of the balloons being raised to operational height, before the aircraft reaches the hostile area.
>
> It will be appreciated that balloon barrages are probably most effective at night, and to remove them for this period would leave undefended a considerable gap in the anti-aircraft defences of vital targets."

Nevertheless it was decided that the point raised by Anti-Aircraft Command and referred by Headquarters, Fighter Command to the Air Ministry must be referred to the Chiefs of Staff, and in the meantime, the arrangements made in the Inner Artillery Zone were allowed to stand.

ibid.
Encl.56A.

/It is not

DESTROYED
KBC/S/54825/Ops
24/3/41

It is not known to what extent this matter was discussed by the Chiefs of Staff or whether the proposal was withdrawn without reaching that stage but in March 1941, Headquarters, Balloon Command, informed all Balloon Barrage Groups that experience had shown that balloon cables seriously interfered with the intricate apparatus which anti-aircraft gunfire at unseen targets was directed. Since every possible means must be used to combat the enemy's attacks, which, hitherto, had been delivered from above the maximum operational height of balloon barrages, it was reasonable that balloons be grounded at night to avoid interference with other defences capable of dealing with enemy aircraft at these greater heights. The location of balloon barrages in this country was well-known to the enemy, but at night, his pilots could not be sure whether the balloons were flying or not, so that it was unlikely that they would attempt low flying attacks. By grounding balloons after dark and reverting to normal operational flying before daylight, the exercise of this control would be concealed from the enemy.

In order to guard against possible low flying attacks, however, barrage commanders were instructed to raise balloons to ruling operational height immediately they received information from the gun operation room or from other sources, of aircraft approaching their barrage below the maximum operational height of the balloons. Headquarters, Anti-Aircraft Command, undertook the responsibility of informing the barrage commanders concerned of raid plots below 6,000 feet, through the gun operation rooms.

As a further safeguard, the Air Officer Commanding the Fighter Group in whose area the barrage was situated, was given over-riding authority to vary the degree of the application of the control in any way considered tactically necessary.

The new arrangement, known as "Gun Operational Control", implemented the policy then in force. It was obvious, however, that no permanent arrangement could be made, as the policy would have to be varied from time to time to deal with the tactical situation.

On the 23rd March, 1941, Balloon Command Air Staff Instruction Part I, No.104 - "Control of Balloons by Authorities other than Barrage Commanders" was issued, laying down the policy to be adopted in all cases of controls over balloon barrages. The section dealing with gun operational control read as follows:-

"Gun Operational Control

The control is granted to A.A. Defence Commanders over all balloons in the barrages specified in Appendix "A". Its object is to remove the interference caused by balloon cables to A.A. gun instruments when engaging unseen targets. As far as possible, balloons which interfere with G.I. instruments are to be grounded after dark and will revert to normal operational flying before daylight with the object of concealing the exercise of this control from the enemy.

/The A.A. Commander

The A.A. Commander will state his requirements daily and will arrange with the Barrage Commander that only those land-sited balloons which actively interfere with G.I. efficiency are grounded or, if water-borne, are hauled down to 1,000 feet. In cases where a reduction in the height of the balloons will overcome interference, the balloons need not be grounded. H.Q. Balloon Command will be informed of the control in operation and its extent by the Dull and Shining message passed at the time the close-hauling is effected.

Termination of control and channels of communication.

The Barrage Commander is to terminate the control immediately he receives any indication, either from G.O.R. or other sources, of aircraft approaching the barrage area at a height of 6,000 feet or less. If the Barrage Commander terminates the control, he is to inform the Fighter Group in whose area the barrage is situated immediately and also H.Q. Balloon Command, by priority telephone.

The Air Officer Commanding of the Fighter Group concerned has an over-riding control and may vary the degree or application of this control in any manner he considers tactically necessary. H.Q. Balloon Command is to be informed by the Barrage Commander of any variation of the control ordered by the A.O.C. Fighter Group. Communication with local A.A. Defence Commander can be obtained via G.O.R. and instructions from A.O.C. Fighter Group will also be passed via G.O.R. or other direct communications if they exist.

The penultimate paragraph quoted above was subsequently altered by an amendment issued by Headquarters, Balloon Command on the 25th April, 1941, to read as follows:-

"If the Barrage Commander receives any indication, either from G.O.R. or other sources, of aircraft approaching the barrage at a height of 6,000 feet or less, he will first confirm with the A.A. Commander that the indicated height is reliable, in which case, he is to terminate the control immediately and order balloons to be flown at Ruling Operational Height. If the Barrage Commander terminates the control, he is to inform the Fighter Group in whose area the barrage is situated immediately and also H.Q. Balloon Command, by priority telephone call.

AM/S.7817.
Encl.4A.
9.2.41.

Close-hauling of Balloons for Gun Calibration.

All authorities concerned were notified in February, 1941 that the Air Ministry had authorised, with effect from the 12th February, 1941, the close-hauling of balloons as necessary, within fifteen miles of gun-laying sets which were being calibrated.

It was laid down that it was the responsibility of the anti-aircraft formation concerned to notify their requirements in this respect to the Fighter Group in whose area they were stationed, who would obtain the necessary authority from Headquarters, Fighter Command.

Balloons that were close-hauled for this purpose were to revert to operational height on the orders of the barrage control officer concerned if the tactical situation made this desirable. When making preliminary arrangements for gun calibration, the anti-aircraft formation concerned could be

/warned

warned by radio-telephony immediately any balloons reverted to operational height likely to affect the aircraft on its agreed course.

~~AB/C.S.~~ DESTROYED
~~5482/Ops.~~
Encl. 6A.
25/5/41.

Three months later, however, the Air Officer Commanding, Balloon Command, found it necessary to draw the attention of the Air Officer Commanding-in-Chief, Fighter Command to the number of occasions upon which various barrages were being regularly grounded for the purpose of gun calibration, with the result that a very large number of balloons were close-hauled during most of the hours of daylight, and while it was appreciated that the balloons could be flown immediately the tactical situation rendered it necessary, it was doubtful whether, particularly in coastal districts, the balloons could be raised in sufficient time to counter an enemy attack on the barrage area.

The Air Officer Commanding, fully appreciated the necessity for gun calibration, requiring, as it did, that balloons be grounded to avoid interference. At the same time, he viewed with growing concern the extension of demands made by anti-aircraft units which appeared likely to grow to such proportions as to render nugatory the existing policy, which laid down the importance of flying balloons during the greatest proportion of daylight and in cloudy weather. Apart from its value as a counter to dive-bombing and low-level attacks by enemy aircraft, a balloon barrage undoubtedly enhanced civilian morale but if balloons failed to be raised in time when an attack developed over an area they were protecting, civilian morale would undoubtedly be adversely affected.

He continued:-

"....I am using every endeavour to speed up communications and the operation of raising balloons into the air with a view to lessening the length of warning required. I nevertheless submit that, unless you are prepared to accept the risk that in a number of cases it will not be possible to get the balloons into the air in time, a limit will have to be drawn to the extent to which balloons may be close-hauled for calibration...."

He put forward the following suggestions which, although not entirely solving the problem, would help to a considerable extent:-

"(i) When permission is given by your Headquarters for balloons to be close-hauled for calibration, it is usually qualified by the safeguard that balloons should go to operational height in the event of the tactical situation rendering it necessary. In general, this has been accepted as meaning when there are hostile plots in the vicinity or a Home Office warning is received. I suggest, however, that if this qualification "subject to operational requirements", can be extended to give barrage commanders discretion to cancel the calibration test if he considers the weather conditions are suitable for a surprise attack by single enemy aircraft using cloud cover, it will materially help the situation.

/(ii)

(ii) It is the practice in the 1st A.A. Division to ask for balloons which affect their gun sites to be hauled down to 2,000 or 1,500 feet, at which heights the interference caused is so slight that it can be ignored. This height appears to satisfy them both for calibration exercises by day and at night when the guns are being used against enemy aircraft. I suggest, therefore, that if this practice is acceptable to the 1st A.A. Division, it could be extended to all divisions throughout the country and would materially speed up the raising of balloons to operational heights."

AHB/IID/34/4/24(E)
~~KBC/S.52073/Ops. Pt.V.~~
Encl.92A.

On the 21st March, 1942, a further variation in operating balloons was introduced, the intention being to keep balloons grounded or at a reduced height by day as well as by night, but always ready to fly to ruling operational height immediately on receipt of a warning that enemy aircraft were approaching the barrage area. The controls set out twelve months previously in Balloon Command Air Staff Instructions Part I, No.104, still continued to apply, except that in the case of Gun Operational Control orders took precedence at night over orders from barrage control officers, and it remained the responsibility of the anti-aircraft divisional commander to notify barrage control of low flying enemy aircraft approaching the barrage area, to enable barrage controllers to order balloons to be raised immediately to ruling operational height.

Air Co-operation Control

The training of gun-site personnel, for which this control was imposed, consisted of two forms:-

(a) aircraft flying at altitude, to exercise gun crews in the operation of predictors and range-finding instruments;

(b) aircraft flying low, to exercise gun crews against dive-bombing attacks.

Prior to the introduction of the new operating policy on the 21st March, 1942, balloons were grounded when Air Co-operation Control was imposed, but on the implementation of the new procedure, balloons were "Dull" when flying at 1,500 feet in first line barrages and when grounded in second line barrages.

By this new instruction, the operational control of all balloons in his area was delegated to Air Officers Commanding Fighter Groups by the Air Officer Commanding-in-Chief, Fighter Command.

AHB/IID/34/4/24(F)
~~KBC/S.52073/Ops. Part VI~~
Encl.22A.
27/4/42.

Some uncertainty was felt by the Anti-Aircraft Divisional Commander and the Barrage Commander in the London area regarding Air Co-operation Control and in April, 1942, Headquarters, Anti-Aircraft Command requested that permission be granted to pass the word "Grounded" on clair, in place of the codeword "Dull" at times when balloons were actually on the ground, the reason being that aircraft co-operating in low-flying attacks might be misled by the codeword "Dull" into assuming that the balloons were grounded, when in fact, they were flying at any height up to 500 feet.

/While

ibid.
331.
7/5/42.

While agreeing that there was no objection to the fact that the balloons were grounded being stated, Headquarters, Fighter Command, in reply refused to authorise any new code-word to indicate a third stage, for universal application.

No.30 Group was informed of the correspondence by Headquarters, Balloon Command, who said:-

ibid.
344.

"....There is rather more in this than is apparent at first sight, in that it is believed that the intention of Anti-Aircraft Command was for the co-operating aircraft to find out from Barrage Control whether balloons were actually on the ground, or at any height up to 500 feet, and then arrange their co-operation and calibration exercises without imposing a specific control. This will, of course, be a dangerous policy as the Barrage Commander will be quite within his rights in putting the balloons up to 300 feet for training in the appropriate circumstances and not informing the AADC...."

ibid.
40A
14/5/42.

In reply, Headquarters No.30 Group pointed out that requests had recently been made by Anti-Aircraft Divisional Commanders, particularly in the London barrage area, for all balloons to be grounded when Air co-operation control was imposed, irrespective of the type of exercise taking place. This had resulted in balloons being grounded unnecessarily with a consequent loss in balloon training.

In order to overcome this difficulty, it was suggested that instructions be given to Barrage Commanders and Anti-Aircraft Divisional Commanders to the effect that when "Air Co-operation Control" was imposed, an indication be given of the maximum height at which balloons might be flown, and in the case of the London barrage, a Squadron area indicated, when it was required that balloons be grounded.

In the meantime, and pending further instructions, arrangements had been made with Headquarters 1st Anti-Aircraft Division that, in the case of the London barrage, the following information would be given by the Divisional Commander Barrage Commander when imposing "Air Co-operation Control":-

"Air Co-operation control" - meaning that all balloons in the barrage would fly at 1,500 feet.

"Air Co-operation Control dive-bombing - indicating Squadron area" - meaning that balloons in the Squadron area would be grounded and the remainder of the barrage flown at 1,500 feet.

ibid.
41A.
18/5/42.

Headquarters, Balloon Command, in reply stated that although it was appreciated that the balloons were either required to be grounded or to fly at a restricted height in accordance with the exercise being carried out, it was most desirable that balloons should be flown for training purposes, if it was not necessary that they be grounded for the purpose of the exercise.

The letter continued:-

"....The number of controls already existing is large, and it is felt that to add to the type of control is not desirable when the existing machinery already

/allows

allows for control either to keep the balloons on the ground or to fly up to a limited height...."

On the 29th September representatives of Anti-Aircraft and Fighter Command, discussed the procedure to be adopted in notifying Divisional Commanders of the raising of balloons on the occasions when enemy aircraft were plotted approaching an area below 6,000 feet and it was decided that Barrage Commanders should inform Anti-Aircraft Divisional Commanders. At the same time, it was confirmed that when a Divisional Commander became aware, from any source, of enemy aircraft approaching a balloon barrage area, below the height of the barrage when under a control exercised by him, it remained his responsibility to release this control immediately and to notify the Barrage Commander, who would then order the balloons to be raised to ruling operational height.

Night Training of W.A.A.F. Balloon Operators.

AHB/IID/34/4/24(D)
~~KBO/S5207/~~
~~Ops.Enc.33A~~
19/12/41.

During December, 1941, Headquarters, Balloon Command pointed out to Headquarters, Fighter Command that owing to the controls exercised over balloons for the safety of friendly aircraft and for gun calibration exercises, W.A.A.F. Balloon operators who had received no night training at Cardington, but who were trained at centres and on war sites, had no opportunity to experience the difficulties of flying a balloon at night until they actually operated in a barrage when a low flying attack developed.

It was suggested, therefore, that authority be given for balloons to be flown up to a height of 300 feet at night for the purpose of training these operators under blackout conditions. Such authority would qualify the close-hauling of balloons for the safety of our aircraft, and include instructions for local arrangements to be made between the barrage concerned and the local anti-aircraft formation in respect of gun operational control.

Headquarters, Fighter Command agreed to the suggestion, and on the 1st January, 1942, Headquarters Balloon Command notified all Groups of this modification to existing policy. Barrage Commanders were instructed to contact local Anti-Aircraft Commanders and obtain confirmation that in flying balloons at 300 feet, interference to G.L. was insufficient to affect the use of the instrument. Should the local Divisional Commander be unwilling to accept balloons at this height when he wished to engage unseen targets at night, Barrage Commanders would ground all balloons flying at this height, should a raid develop.

Balloons for Gun Calibration.

AM/S/7817
Encl.1A
29/12/40.

Certain LZ balloons (known as "Nomad" balloons) were loaned to Anti-Aircraft Command for the purpose of gun calibration. At the end of 1940, there were thirty-six such balloons in use. Headquarters, Anti-Aircraft Command, now intimated that they proposed to extend considerably their use in connection with gun calibration and for this purpose would require the use of an increased number of balloons.

To meet this requirement and to obviate, if possible, the use of the LZ type, it was arrange with Anti-Aircraft Command to lighten the apparatus to be lifted into the air sufficiently to enable Mark VI type balloons to be used. The Air Ministry

/was requested

was requested to approve the substitution from which it was pointed out had the following advantages:-

(a) A considerable saving in hydrogen would be effected, since the LZ balloon had to be deflated each time it was moved from one battery to another, whereas it was possible to move the Mark VI balloon from one gun site to another by motor transport, without deflation. Even so, the low hydrogen content of the Mark VI in comparison with that of the LZ balloon made it considerably more economical.

(b) A saving in personnel would be effected.

(c) LZ balloons so released could be used to expand barrages where they were urgently needed.

ibid. Encl.3A 28/4/41.

At a meeting held at Air Ministry on the 28th January, 1941, to discuss the requirement, the Anti-Aircraft Command representatives confirmed that experiments carried out with Mark VI and VIA balloons for G.L. calibration purposes, had proved successful. It was, therefore, agreed that the Mark VI could be substituted for the LZ balloon, provided it was rope-rigged.

The requirement at that time for Very Low Altitude balloons for calibration purposes was in the neighbourhood of two hundred, but it was not possible to say what the ultimate requirement would be. It was suggested that the method of introducing these balloons should be by the replacement of the existing thirty-six balloons with Mark VIA types, and an immediate expansion of the VIA strength from thirty-six to seventy-five.

On the 28th May, 1941, the Air Ministry confirmed that it was in a position to supply seventy-five balloons out of the total number required, and requested that the War Office would forward the necessary requisition to regularise the position.

Headquarters, Anti-Aircraft Command were notified on the 15th June that thirty-seven suitably rigged Mark VI balloons were immediately available, together with Admiralty-type hand winches, at the appropriate Balloon Centres where arrangements had been made for the equipment staffs to issue the equipment as in order to avoid complications it was proposed to regard each Army anti-aircraft balloon crew as a detachment of a Royal Air Force Balloon Centre for this purpose.

ibid. Encl. 27A & 28A. 5/5/42.

During the spring of 1942 the policy regarding the calibration of Army radar equipment was modified and the responsibility for the use of balloons for anti-aircraft guns in this connection was vested in Royal Army Ordnance Corps radio maintenance personnel. In consequence, an additional two hundred and four Mark VI balloons, complete with ancillary equipment were now required by the War Office to be held by the Royal Ordnance Corps units servicing radar equipment wherever it was in use by the Army.

/While

While there were no difficulties in providing these balloons, together with the massing of hydrogen for use in this country, there was a possibility that the provision of the latter overseas might prove embarrassing owing to supply difficulties. A meeting was, therefore, held at the Air Ministry on the 15th May to discuss the provision of Mark VI balloons and ancillary equipment required for the calibration of army radar equipment. The War Office representatives asked for a considerable increase in the units for anti-aircraft calibration by the provision of more Mark VI G.L. balloons. This increase would normally have required starting production ab initio and taken some six months to assemble the necessary equipment for operations but fortunately it was possible to meet the demand by provisioning from Air Ministry surplus stocks.

ibid.
Encl.35B
15/5/42.

Combined Defence Tactics.

At the beginning of September, 1940, certain alterations in tactics were put into effect at coastal barrages which were subject to attack by enemy fighter aircraft, for the purpose of shooting down the balloons prior to a dive-bombing attack.

AHB/IIH/240/4/142
~~FO/S.21060~~
Encl.2A.

The success of these tactics had been demonstrated at Dover where the barrage had recently been attacked by enemy fighters. By previous agreement with the local Anti-Aircraft Commander, the balloons were flying at 3,500 feet and a protective box barrage was put up. The enemy aircraft succeeded in shooting down all the balloons in the barrage, and three enemy aircraft were shot down. By the afternoon of the same day, eighteen of the twenty-three balloons had been replaced, and in a smaller attack fifteen were again shot down.

The balloons were replaced a second time and were flying the following morning when Me.109's attacked the barrage. This time, however, it had been decided that the barrage should be hauled down to 500 feet if attacked by fighters, in order to bring the full effect of all anti-aircraft defences into play. The Anti-Aircraft gunfire was so intense that three Me.109's were destroyed for the loss of only two balloons.(1)

Amended operational instructions were put into effect at all coastal barrages which were considered particularly vulnerable to enemy fighter attack.

ibid.
Encl.2B.

At all times when balloons were flying, 50% of the barrage ("A" balloons) were to be flown at 2,500 feet, staggered down to 1,500 feet and the remaining 50% ("B" balloons) were to fly at 500 feet or as near that height as existing weather conditions permitted.

In the event of an attack by hostile fighter aircraft, the "A" balloons were to be hauled down as quickly as possible to the height of the "B" balloons, thus enabling full advantage to be taken of the protective barrage provided by all the anti-aircraft guns.

In the event of a bombing attack taking place, either following or without a fighter attack, "A" balloons were to be raised to ruling operational height and staggered, while "B" balloons were to be raised and staggered from 2,500 feet down to 1,500 feet.

/These

(1) See page 355.

These instructions applied during the hours of daylight and at night, if it was considered that the visibility was such that balloons could easily be seen by the attacking aircraft. When cloud conditions were such that the balloons could, with some certainty, be well hidden in them, these instructions would not apply, but normal operational practice would be adopted.

The purpose of these operational orders was to ensure that a proportion of the barrage was always available to counter a bombing attack following a fighter attack, and it was, therefore, necessary that care be taken in selecting the sites of the "A" and "B" balloons, so that if all the former were shot down, the latter would still provide a barrage, the pattern still providing the maximum protection to vulnerable points.

ibid.
Encl.2C.

Headquarters, Balloon Command notified all Balloon Barrage Groups of these new tactical instructions, and at the same time dispatching a letter on the tactical use of balloons in co-operation with anti-aircraft defences, which stated that:-

> "Hitherto the tactical aspect of balloon barrages has been limited to an agreed operational height, thereby raising a cable barrage to that height. In order to make the balloons less vulnerable to enemy aircraft attack, they are hidden in cloud if this is possible, even at the expense of height.
>
> Consideration has recently been given to developing further tactical uses of balloons and to affording them protection by anti-aircraft barrage when they cannot be hidden in cloud.
>
> A.A. Command have already agreed to put up protective gun barrages round balloons when attacked, and conversations have also taken place with them on methods to increase the tactical value of balloons, in which direction it is realised considerable scope exists.
>
> The best results will undoubtedly be obtained by close liaison between the Barrage Commanders and the local A.A. Commanders, since the governing factors vary considerably at different places".

Barrage Commanders were, therefore, to be instructed to contact local Anti-Aircraft Commanders and to make joint recommendations. Suggestions put forward were not to involve re-siting and were, as far as possible, to come within the scope of Air Staff Instructions, Part I.

Concurrently, Headquarters, Anti-Aircraft Command wrote to all Anti-Aircraft Divisions, informing them of the conversations that had taken place as to the possibilities of co-operation between balloons and heavy and light anti-aircraft guns, both to inflict casualties on the enemy and to protect the balloons in their defensive role.

The letter continued:-

> "....There are various ways in which A.A. guns and balloons may work together. Among these are:-

/(a)

AHB/IIH/240/4/142
~~FC/S.21060~~
Encl.1A

(a) The use of a balloon or balloons as a bait to attract enemy aircraft to attack them and to arrange barrage fire at the known height of the balloons.

(b) Close-hauling balloons to leave lanes in balloon barrages and to cover these lanes with barrage fire.

(c) Variations in height of the balloon barrage to assist gun barrages.

Other ways will occur to A.A. Defence and Barrage Commanders."

Divisional Commanders of defended areas, where there was a balloon barrage, were instructed to contact the Barrage Commander and make suitable arrangements for co-operation and to report any methods of co-operation found successful, in order that other Division might be informed of them.

/SECTION 11.

SECTION 11

HIGH ALTITUDE BALLOONS - 1939/41

The aspect of high altitude balloons between 1927 and 1936 has been described in Part I of this narrative which deals with the research and experimental problems up to the middle of 1936. From that time until July 1939, progress was extremely slow, mainly owing to the pressure of other work.

OS/40712 Encl.62A. On the 21st May, 1939, a conference on kite balloon research was held at the Air Ministry when it was decided that research on the problems of high altitude balloons should go forward. The outcome was that the Director of Scientific Research instructed the Superintendent of the Balloon Development Establishment to proceed at once with the design and manufacture of two experimental balloons of the lobular (1) expanding type capable of reaching a ceiling of 20,000 ft. This research was destined, however, to have an extremely short life, as on the 15th January, 1940, these instructions were cancelled and the work discontinued.

ibid. Encl.72A. The subject was reopened again in July 1940 when Headquarters Balloon Command were informed by the Air Ministry that as the result of experiments it had been found practicable to fly a skeleton barrage at 10,000 ft. This emanated from a minute to the Deputy Chief of the Air Staff from the Assistant Chief of the Air Staff (Technical Requirements) in which he said:-

ibid. Min.76A.

> "...We are anxious to increase the moral effect, especially by night, of the balloon barrage. We know from certain reports, that it has had good moral effect and that it is believed that our balloons can ascend to great heights. In order to increase this effort, could we not display a few balloons at a very great altitude? The enemy pilot is not to know that it has reached its altitude because it is being flown on a very much less robust cable than the standard one, the proposal being that a few balloons should be supplied with a special light cable enabling them to go to a very high altitude. A few balloons seen in this way, by day-flying reconnaissance aircraft will give the impression that our balloon barrage can operate at high altitude when cloud conditions make this desirable and the moral effect would be greatly increased....."

Balloon Command were instructed to obtain, with the least possible delay, a light weight cable which could be used with their existing equipment. The ordinary LZG (2) type balloon had already been used with a light cable and flown to heights of 10,000 feet and above, but on all occasions when hauled down the balloon had almost completely lost its shape owing to lack of gas pressure.

/Experiments

---

(1) An extensible balloon with rigid fins, with a ground volume of 30,000 cu.ft.

(2) L-Z Balloons were given serial letters for each type manufactured. The L-Z.G balloon was made of improved fabric but in all essentials was exactly similar to the ordinary L-Z balloon.

Experiments at Cardington.

Bearing this fault in mind, Balloon Command suggested that two further experiments should be made at Cardington; the first, to introduce an additional gore in the ballonet of a standard balloon and to modify the existing valve so that it was actuated by pressure instead of by valve line; the second, to redesign the diaphragm and raise the position of the diaphragm seam between two to two-and-a-half feet, thereby increasing the ballonet capacity to accommodate the expansion of gas at 10,000 ft. It was suggested, too, that one of the "G" type balloons at present being manufactured should be modified in accordance with the second suggestion.

Their experiments were successful. Difficulties had been foreseen in regard to arming the new light cable. However, it was considered that no delay should occur because of this, the main object being to fly a few high altitude balloons in all the important barrages. Accordingly on the 9th August, 1940, Headquarters, Balloon Command, requested permission to fly high altitude balloons in the following barrages:-

London
South Wales
Portsmouth
Southampton
Avonmouth
Plymouth
Sheffield

The East Coast barrages had been excluded because of the Operational Fighter Control which existed.

Winches

Certain modifications had to be made to the standard winches which were to carry the new 25 cwt. cable.

Mark II Winches	(a)	Reverse the chain sprocket on the serving gear drive, attaching the 34T to the storage drum and the 44T to the serving box.
CS/40712 Encl.98A.	(b)	Reduce the tension on the friction drive to approximately 40 lbs.
Mark III Winches	(a)	Reduce the tension on the friction drive to approximately 40 lbs.
	(b)	Reduce the drag of the storage drum brake to approximately 40 lbs.
Mark IV Winches		Not recommended that this type should be used.

Cables

ibid. Encl.106A. In September 1940 production of the first two sets of fifty cables each was well under way, the specification being:-

	First Fifty	Second Fifty
Length	14,000 ft.	14,000 ft.
B.L.	25 cwt	25 cwt
Construction	6 x 7 over fibre core	6 over fibre core
Diameter	.169 inches	.151 inches
Weight per 1,000 ft.	41 lbs.	41 lbs.

/The Balloons

The Balloons fly with Unarmed Cables.

The first high altitude balloons were flown from Regents Park, London, in September 1940, and for the next two months twenty-five of these balloons were flown, fifteen in London and ten in the Birmingham barrage. They were only flown during daylight hours, when wind speeds up to 10,000 ft. did not exceed 30 m.p.h. and when there was no risk of lightning. In practice, the operation was successful but a very high standard of balloon handling was required and the speed of hauling down these balloons was about half that of a normal LZ barrage.

Having proved that balloons could be flown successfully at 10,000 ft., the main difficulty which now presented itself was the arming of the cables, as it was considered that with the introduction of bumpers on aircraft an unarmed cable would be useless. The most promising method of doing this was to attach a small bomb to the cable, so that on impact the lower end of the cable was automatically severed, and the cable and bomb dragged up to the wings of the aircraft. Another scheme put forward was that a larger balloon should be used, flying on a 2¼ ton cable armed with a double parachute link, no existing unit being suitable for the 25 cwt. cable. Parachute arming was experimented with, but no successful solution to the problem was found.

S.40712
Encl.129A.

Although the Assistant Chief of the Air Staff (Technical Requirements) had directed that the 10,000 ft. barrage be made lethal as an operational requirement, this met with such opposition from the Air Member for Development and Production (Sir Henry Tizard) that in December 1940 the requirement was withdrawn. Authorizing the retention of a small number of these high altitude balloons to be flown in selected barrages as unarmed scarecrow units, the Air Ministry intimated that a small number of H.Z. type balloons (35,000 cubic feet) were to be constructed, which it was proposed should be flown, in addition, under suitable conditions, on 25-cwt unarmed cable purely as scarecrows.

Further Experiments:

(a) Kites

ibid.
Encl.125A.

In spite of all the inherent disadvantages in the use of kites, a suggestion was put forward by the Air Officer Commanding, No.32 Group (Air Commodore A.A. Walser) whereby the flying of kites from balloon cables would give the additional altitude required. The idea was that a kite could be attached to the cable, whereby it would launch itself and fly as soon as the balloon was raised.(1)

Under arrangements made by No.32 Group, a kite was flown from a separate winch, the cable leading round a pulley fixed to the balloon cable approximately 400 feet below the balloon. It was claimed that by this method kites could be flown at 10,000 feet from a confined site, in conditions which would not have allowed launching by the normal method.

Permission was duly given to fly kites from balloons up to 9,000 feet in the Plymouth barrage. The trials proved successful enough and in January, 1941, the Balloon Development Establishment took over the experiments which were continued at Cardington until May.

/(b) Tandem

(1) See pp. 311-315.

(b) Tandem Balloons

Before experiments on the high altitude barrage finally ceased during this period of playing with kites, a further scheme involving balloons flown in tandem was tried.

The Air Officer Commanding, Balloon Command (Air Vice-Marshal O.T. Boyd), writing to the Air Officer Commanding-in-Chief, Fighter Command, on the 12th October 1940 said:-

> "... An unofficial experiment indicates that a small balloon modified from the general Mark VI type now being produced for estuary and ship work, can be flown above the L.Z. balloon on a thin wire to give a further height of 2,000/3,000 feet ....."

The lower balloon to be used was to be an LZ.J (2,300 cu.ft.), flying on 3½ ton cable armed with the existing pattern D.P.L. The upper unit was to be a V.L.A. type balloon (4/6,000 cu.ft.), flown on 13 gauge piano wire. The idea was to fly the upper balloon in tandem from a standard Mark VI winch, using a detachable drum from a Wickham winch mounted on a special shaft.

The first unit of two balloons flown in tandem was flown experimentally from Regents Park, on the 15th February 1941, with the result that two major problems arose at once:-

(a) The upper unit would not stand up to the same wind speeds as the L.Z. balloon.

(b) Approximately two hours was required to haul down the unit from the flying position.

The latter difficulty presented the greater of the two problems as quite obviously the time lag was far too great and it would be impossible to use these high altitude balloons in barrages near aerodromes or over which a control was operating. It was decided, therefore, that their use would be limited to barrages where indication of the target was of the least importance or when not sited on a regular route used by operational aircraft and not sufficiently near aerodromes to interfere with flying.

ibid.
Encl.155A.

The following barrages were suggested as conforming with these conditions:-

London	80	High	Altitude	Balloons
Liverpool	40	"	"	"
Portsmouth	20	"	"	"
Manchester	30	"	"	"
Sheffield	30	"	"	"
Newport	15			

With these points in mind Balloon Command pressed forward with the service trials of the 12 tandem balloons available.

/The Trials

The Trials Discontinued.

On the 22nd May 1941, however, a report was submitted to the Air Ministry by the Air Officer Commanding-in-Chief, Fighter Command, in which the following major criticisms were made:-

ibid.
Encl.165A.

"(a) The difference in equipment, performance and methods of handling this type, as compared with the standard L.Z. will introduce undesirable complications.

(b) The marked increase in the period necessary both to raise or lower this type will make it extremely difficult, if not impossible, to apply any forms of operational or safety control to the barrages affected. The balloons will have an adverse effect on G.L. equipment and AA efficiency.

(c) The use of these balloons will increase the danger to friendly aircraft, which is already sufficiently serious to cause concern.

(d) The use of enemy aircraft fitted with effective bumpers would make the upper units flying on piano wire completely useless."

The Commander-in-Chief concluded his report with:-

"....I consider that any attempt to use these balloons is likely to have such repercussions on operational training requirements that a general conference to settle all relevant details will be essential before any steps are taken to employ these balloons operationally..."

ibid.
Encl.170A.

The result of this letter was a direction from the Air Ministry that all action should cease on the development of high altitude balloons.

/SECTION 12

SECTION 12

KITE DEVELOPMENT

Work on Kites by Royal Aircraft Establishment, 1937-38.

S.41840

In July, 1937, the Director of Scientific Research suggested that kites might be used to increase the altitude obtainable by barrage balloons. As a result of his representations kites were given a definite place in the Defence Programme on Priority "B". The Royal Aircraft Establishment, which had already given some consideration to the problem earlier in the year, forwarded their conclusions to the Air Ministry on the 15th March, 1938. They pointed out that there were two serious disadvantages in a dual system. First, balloons designed to have a comparatively low blowing-away speed in a steady wind would be appreciably unsafe in certain gusty conditions. Secondly, the changes of wind speed up to 20,000 feet might be both considerable and erratic, and it was possible that a wind of, say, 30 miles an hour at 20,000 feet would be associated with one of 40 or 50 miles an hour at lower levels. Thus there would always be uncertainty whether balloons or kites should be used, in addition to the danger of a sudden change in conditions making the balloons unsafe.

However, kite-assisted balloons did possess certain advantages. There is an intrinsic upper limit to the height to which a cable of given strength and weight can be lifted by means of a single lifting agency such as a balloon or kite. This limiting height is determined by the weight and air drag forces on the cable, and falls considerably with an increase of wind speed. Thus, to reach a height of 20,000 feet a very strong cable (and in consequence a very large balloon) is required.

The height limit, stated the Royal Aircraft Establishment, could not be raised by improvements in the design and characteristics of the balloon. It could be raised, however, by attaching a series of kites along the flying cable. Calculations indicated this would reduce the cable strength required and would allow for a reasonable sized balloon.

Kites used by themselves as a low altitude barrage might be suitable for defending isolated targets against dive and low level bombing, and would be particularly useful for the defence of ships, where favourable conditions for flying kites would be the rule rather than the exception. In general, the Royal Aircraft Establishment considered that kites merited further investigation with a view to their use in all these roles.

Advantages and Disadvantages of Kites for Barrages.

ibid.
Enc. 15B

The advantages and disadvantages of kites for barrages were fully outlined in a note circulated in May, 1938, by the Director of Scientific Research to the Committee for the Scientific Survey of Air Defence. By this time it was known from intelligence sources that air barrage units in Germany were equipped with balloons and kites.

/Kites

Kites had an outstanding advantage over balloons of being able to operate in medium or high winds, instead of being limited to calm or light winds. Moreover, they were likely to be cheap both in initial cost and maintenance; required no additional means of protection, being almost impossible to shoot down; were not dependent on the production and transport of large quantities of hydrogen; and were extremely mobile, as, if the kites were collapsible they could be hauled down and packed for transport, and launched again comparatively quickly on arrival at their destination.

On the other hand kites could only be operated if the wind speed exceeded a certain minimum.(1) Operation in confined spaces presented difficulties, owing to probable instability in gusts near the ground. In addition when lethal devices employing bombs were attached to the cable, it would probably be necessary to leave an appreciable length of cable near the ground unarmed, in order to avoid bombs hitting buildings if the wind dropped suddenly.

Finally, if used in conjunction with balloons there might be operational disadvantages in the dual system, from the point of view of equipment and personnel. On balance, however, the Royal Aircraft Establishment considered that kites had a possible application as means of lifting lethal cables:-

(a) As an alternative to balloons for low altitude barrages in relatively high winds.

(b) In combination with balloons, for high altitude barrages.

(c) For the protection of ships against low flying attacks.

They suggested, therefore, that a kite should be designed capable of lifting a lethal cable to a height of 4,000 feet, and a number of experimental kites constructed in order to obtain experience in their operation.

Decision by Committee for Scientific Survey of Air Defence.

ibid. Encl.13A

The Committee for the Scientific Survey of Air Defence at their 41st meeting on the 19th May, 1938, approved this proposal, which was added to the Royal Aircraft Establishment's research programme on Priority "A". It was agreed that if the kites proved satisfactory in design they might be useful both for low altitude barrages on land, and for the protection of ships at sea, but that their employment in a series to lift a cable for a high altitude barrage was to be deferred as a long range possibility.

Progress with kites up to December 1938

ibid. Encl.55A.

During October, 1938, steps were taken by the Royal Aircraft Establishment to prepare for the eventual possibility of a large demand for kites by making preliminary enquiries concerning production. The preparation of drawings was also put in hand, though there was as yet no operational requirement. By the end of the year experiments were progressing satisfactorily.

The main problem was to produce a kite suitable for a 4,000/5,000 feet barrage. A number of Cody kites were made and tested in the wind tunnel. These kites were robust, easy

/to produce,

(1) In the case of the early man-lifting kites this was about 20 m.p.h.

to produce, operate, store and maintain. It was expected that the kites could be launched in winds of 15 miles an hour and that three or four such kites, probably armed with aerial mines, would provide a barrage unit capable of flying to 5,000 feet.

A glider type kite with a high lift ratio had been evolved and flown, but proved laterally unstable and was being replaced by a pterodactyl type.

The chief limitation to the use of kites from land stations was found to be the minimum surface wind of about 12/15 miles an hour required for launching and a scheme for assisting the kites by means of rubber balloons, inflated with hydrogen, was under consideration as a method of overcoming the difficulty.

Technical Progress. January-April, 1939.

ibid. Enc.56A.

Progress continued on these lines during the spring of 1939, and 2-feet and 3-feet Cody kites were launched in mean winds ranging from 20/40 and 15/30 miles an hour respectively, both types sustaining winds up to 50 miles an hour at height without damage. Causes of occasional instability were under investigation. The performance of a barrage was found to be very sensitive to wind strengths and the stronger the wind the fewer the kites needed. It was considered that one rubber balloon 8 feet in diameter would be sufficient to raise a kite even in the highest winds.

Economy of Kite Barrage Units

ibid. Enc.59A.

A kite barrage unit was clearly much cheaper than a balloon barrage unit. The cost of a standard box kite was estimated in April 1939, at about £15, and the flying cable and arming devices at probably about £100 per unit. The flying cable was planned to consist of a series of aerial mines, end to end, each between 1,000 and 2,000 feet in length, and connected by inertia links. The estimated cost of an experimental engine-driven winch in process of construction was £200, as opposed to about £500 for a standard balloon winch. The whole process of transport, erection and launching required only a small crew with a lower standard of training than that of a balloon crew.

Suggestion for an Experimental "permanent" Kite barrage.

ibid. Enc.109A.

By July 1930 a considerable number of experimental flights with Cody box-type kites had been made at the Balloon Development Establishment, Cardington, and the equivalent of a lethal cable had been raised by means of kites to 8,000 feet. A preliminary demonstration given to representatives of the Air Staff and Headquarters, Balloon Command, on the 3rd May, 1939, was not altogether satisfactory owing to low wind speed, and it was questioned whether a single demonstration could really ever be satisfactory in view of the difficulties involved. This led to an Air Staff proposal that an attempt should be made to fly a "permanent" kite barrage from some suitable site, so that records and information of its operation could be obtained at regular intervals, and could be more easily on view to representatives of the Air Staff and others, while at the same time the handling personnel would gain valuable experience. The barrage was to consist of a number of kites

/each

each on a single cable, flown at 5,000 feet whenever weather conditions permitted, and kept up day and night as long as possible.

Admiralty Interest in Kites.

ibid. Enc.129A.

Development work on kites was stimulated by the heavy losses sustained by balloons during the first few months of the war. It was decided to provide an experimental kite barrage as a supplement to the defences of Scapa Flow, where high winds would favour the device, and the question of training naval, together with balloon, personnel in the technique of handling kites at Mullion in Cornwall was taken up with the Director of Naval Co-operation.(1) As far back as the Spring of 1939 the Admiralty had made preliminary enquiries into the possibilities of flying kites as an alternative to balloons for the protection of ships, and in November they asked for the co-operation of the Air Ministry in investigating the problem. With the assistance of the Research Department at Exeter, Commander Dove, R.N., carried out sea trials with Cody type kites, and also of a special Admiralty type, and found no serious difficulty in launching kites from ships provided there was sufficient wind. The Admiralty made considerable progress in the development of a lethal kite, and the apparatus was put into production on a large scale.

ibid. Enc.132B.

ibid. Enc.132A. Min.139.

Summary of Progress up to May 1940

AHB/D/34/5/1 ~~KBO/S.50014/~~ ~~Org.~~ Enc.3B.

On the 1st May, 1940, a meeting was held at the Air Ministry to discuss the development of the Kite Barrage, and arrive at some conclusions in the light of the experimental work so far carried out. It was learned that at Mullion the 3-feet Cody kite had proved satisfactory in winds up to 80 miles an hour, and could be launched in winds from 12 to 30 miles an hour, but that the 2-feet type was occasionally unstable and required a minimum launching wind of 20 miles an hour. A type designed by Commander Dove had not yet proved itself strong enough for service use. A converted Ford V.8 winch had been in use for three months, and a specially built Morris winch at Mullion seemed likely to prove very satisfactory. At Plymouth, where experience with kites had been much the same, a balloon winch attachment had been tried out with some success. Eight men were in training at Exeter, and twenty trained at Mullion had now proceeded to Scapa, where Commander Dove's experiments had so far been limited through lack of high winds.

It was decided that experiments should continue with all three types of kite, and that, if possible, the 3-feet Cody kite should be launched in winds above 30 miles an hour, and flown in winds of 80 miles an hour. Balloon Command and the Research Department at Exeter were required to co-operate closely in carrying out trials with the Morris winch and balloon winch attachment, on high priority, and together with the Directorate of Armament Development aim at simplification of design. Service trails with the lethal device were also to take place as soon as possible, and the speeding up of the manufacturing process was to be explored.

It was agreed that the immediate aim was to produce a lethal barrage; that the substitution of kites for balloons was only practicable in unrestricted areas; and that the use

/of a barrage

(1) The kite flying experiments at Mullion were under the direction of Professor F.T.S. Hill, then in charge of the Air Defence Section of the Royal Aircraft Establishment at Exeter.

of a barrage consisting of kites only was limited by meteorological conditions.

As regards organisation and training it was decided that the Air Officer Commanding, Balloon Command, should develop a complete small kite barrage of two flights (16 points) and should also consider the establishment of a small training unit for kite development, to be given a high degree of priority.

Formation of Kite Training School, Plymouth.

ibid. Enc. 1A

As a result of these decisions, Air Ministry authority was given for the formation of a Kite Training School at No.13 Balloon Centre, Plymouth, with effect from the 27th May, 1940, the personnel for training being drawn from No.934 Squadron. It was arranged that eight crews of six men each should be trained at one time, occupying eight selected sites. The equipment consisted of 32 3-feet kites, 12 2-feet kites and 9 kite winches.

ibid. Enc. 15B

A complete small kite barrage was also formed at Plymouth, and operated there for the next few months. The experience gained was on the whole discouraging, and suggested that the Cody kite was of little use in low ground winds; that a dual kite and balloon barrage was unsatisfactory; and that a crew of 9 men was required to fly kites.

Air Ministry Conference, August 21st 1940

These conclusions were considered, together with other evidence based on recent experience, at a further conference held at the Air Ministry on the 21st August, 1940. The progress made since May was analysed, and it was learned that the 2-feet type was now considerably more stable, and could be launched in winds up to 35 miles an hour, while 800 merchant vessels had been fitted with the Admiralty pattern, which was much stronger than the original version, but had not yet been made lethal. A light wind type, the Brook kite, had also been produced, which could be launched in winds of 7 miles an hour. Tests with bombs had proved successful, and both the Morris winch and the balloon winch attachment had been found satisfactory.

In spite of these advances it was agreed that the practicability of flying kites in wind speeds higher than those safe for balloons had yet to be proved. (No further progress had been made with the 3-foot Cody kite through lack of suitable wind velocities). It had been found that kites and balloons could not be flown together in the same barrage, if normal spacing were used, for fear of cable fouling; neither could a kite barrage on its own be regarded as a satisfactory replacement for a balloon barrage, as flying hours were generally too limited and uncertain. At Mullion, however, kites had been flown on 50% of occasions since the 1st May at the operational height of a balloon barrage. It was reaffirmed that kites had no value in congested areas.

In the face of so much discouraging evidence, the policy was changed, and it was decided that at present the use of kites should be limited to a barrage at Scapa, as an alternative

/to the balloon

to the balloon barrage; the protection of ships under way, (for which they had proved satisfactory except in the case of slow speed vessels); and possibly to a special kite element in the mobile balloon barrage. Kite development was to be limited to their use in these roles. The kite barrage at Plymouth was to be disbanded, and the Kite Training School reformed at Exeter.

Scapa Barrage.

It was agreed that the barrage at Scapa was to consist of 56 points, the equipment being an equal proportion of 3-feet and 2-feet Cody kites armed with the Mark VI bomb and a type of winch to be decided on. The organisation necessary to operate the barrage was to be settled by the Admiralty and Air Ministry together, and it was recommended that a naval liaison officer should be appointed to Headquarters, Balloon Command.

ibid.

Objections raised by Air Officer Commanding, Balloon Command.

The Air Officer Commanding, Balloon Command, was not satisfied with the decisions reached. His causes of complaint were that the kite was not yet sufficiently developed to be a satisfactory alternative to the L.Z. balloon; that this deficiency was aggravated by the lack of a suitable winch for conditions prevalent at Scapa; and that tensions of anything over 400-lbs on the cable would make the lethal equipment valueless. (In this last point he proved to be wrong). These objections were overruled in view of the undertaking already given by the Air Ministry to the Admiralty to provide a barrage at Scapa, but it was agreed that any extension of the employment of kites should await the outcome of practical experience. Valuable information was hoped for from the flying of kites at Scapa throughout the winter months.

ibid.
Enc.16A

Progress of Scapa Barrage

After much discussion it was finally arranged that the kites at Scapa were to be flown from forty-four land sites at a height not exceeding 5,000 feet, whenever weather conditions were likely to cause severe casualties to balloons; and that they were to be operated by balloon crews augmented by kite trained personnel from No.34 Group. In addition six kite instructors were to be sent from No.32 Group. All material for the kites was to be provided by the Admiralty and a naval expert was to be attached to No.20 Balloon Centre to assist and advise in the flying of the Admiralty pattern kite.

ibid
Enc.21A

Causes of Delay.

The deployment of the full barrage was delayed for some time owing to the refusal of the Admiral Commanding, Orkneys and Shetlands, to allow lethal kite devices in the area, and kite development proceeded on low priority until this objection was withdrawn on the 25th November. Further delays were also caused by lack of equipment; and deliveries of kites, winches, and inertia links were still awaited at the beginning of 1941. By this time the 3-feet kite had proved unsatisfactory, and the contract had been cancelled, while the question of winches was still in the experimental stage and remained unsettled. Forthcoming supplies of metal hand-winches had been provisionally allocated to Mark VI balloons and no contract had been placed for Morris winches. A few unreliable Ford winches were in use by No.32 Group at Plymouth, but none were available for Scapa.

S.5380
Enc.20A
Enc.22A

AH6/UD/34/5/1
~~KBC/S.50014/Org.~~
Enc.39A

/Abandonment

Abandonment of Low Altitude Kite Barrage Scheme

S.13980 Enc.36B.

At a conference held at the Air Ministry on the 28th January, 1941, it was agreed that operational experiments over the past year had been universally unsuccessful in producing a satisfactory form of land kite barrage. Factors influencing this decision were the number of occasions on which it was not possible to launch kites owing to lack of wind; the lack of a kite robust enough to stand up to greater wind speeds than the average L.Z. balloon; and the difficulties of launching and flying kites from enclosed sites owing to the low angle of the kite wire.

Disbandment and Disestablishment of the Kite Training School

~~AHB/ID/34/5/~~ ~~KBC/S.5001/~~ ~~Org.~~ Enc.29A.

As a result of the decision on kite policy made on the 21st August, 1940, it had been laid down that the Kite Training School should be disbanded, but not disestablished in case it might have to be restarted. It was recommended that the personnel should be absorbed by the Scapa barrage and other units, but their movements annotated in case they were required at a later date. Following a special request from the Air Officer Commanding, No.32 Group (Air Commodore A.A. Walser) however, a number of airmen were retained after the disbandment of the School to form the nucleus of an experimental unit and remained until June of the following year. It was not until the close of these experiments, when all equipment was transferred to Cardington, that the school was officially disestablished on the 17th June, 1941. Some account is necessary of the experiments carried out in No.32 Group which, though inconclusive, carried kite development a stage further in a new direction.

ibid. Enc.30A.

ibid. Encs.41A & 42A.

Walser Kite and Balloon Scheme, October 1940 - August 1941

S.B.13980 Enc.34B.

After the disappointing experiments at Scapa and Plymouth during 1940 had shown that a low altitude kite barrage was an impracticable substitute for a balloon barrage, attention was turned instead to experiments with a combined kite and balloon barrage at high altitude. This scheme, which was initiated by the Air Officer Commanding No.32 Group (Air Commodore A.A. Walser) was based on considerable expectations, and did much to justify them, but after meeting with little support from other quarters eventually died a lingering death. It was hoped that it might overcome the main disadvantages which had been found inherent in the Balloon Barrage, namely the limiting height of approximately 6,000 feet, the severe losses incurred in bad weather, and the frequent cases of damage by lightning. At the same time it was thought that by raising a kite from a weak link or automatic launching device fitted to a balloon cable, and thus reaching a higher altitude, it would be possible to fly the kite successfully when the wind at ground level was negligible, even from an enclosed site. Hitherto a kite barrage had been limited by the inability to launch kites in winds of under 12 to 15 miles per hour, or to fly off enclosed sites owing to the low cable angle inherent in a kite flying at a high altitude. A combined Kite and Balloon Barrage was also regarded as less likely to suffer from enemy air attack or act as a target indicator.

Experiments at Tichfield and Plymouth

Permission to try out the enterprise was obtained in October, 1940, and preliminary experiments began at No. 12 Centre, Tichfield. In spite of the primitive equipment available, the idea was soon shown to be feasible, and a kite was successfully launched and flown from a balloon cable on days when, owing

/to lack

to lack of wind at ground level, it would not have been possible to launch it off the ground by orthodox methods. The experiments were then transferred to Plymouth, and continued on a larger scale in "B" Flight of No.964 Squadron at Torpoint, from the 30th November, 1940, up to the end of April 1941, the Kite Section being under the charge of Flight Lieutenant C.V.L. Hooman, who was given much valuable assistance and advice during part of the time by Mr. W. Smith from Mullion. The actual work was undertaken with kite-trained personnel, who were scattered among the crews in the Flight, and passed on their knowledge to the balloon operators. Altogether a total of 2,894 kite flying hours was carried out at Torpoint. In March the temporary transfer of the experiments to Cardington was reconsidered, as the flying of unmarked cables over 5,000 feet at Plymouth was thought undesirable, and it was found impossible to comply with this restriction.

ibid.
Enc. 20A

Results.

A report by Air Commodore Walser on the outcome of the Kite-cum-Balloon trials, together with recommendations on future policy, was forwarded to the Ministry of Aircraft Production on the 21st May, 1941. The results of the experiment had effectively demonstrated that given suitable conditions, it was possible to maintain a combined Balloon and Kite Barrage in the air continuously for long periods, and to fly it to an altitude of 9,000 feet of paid wire. Had it not been for operational restrictions a greater height might have been achieved. The Kites might be launched in three different ways - either by hanging loosely from a balloon cable lead-off on a short, medium, or long leg of flying wire; from the site, sending the flying-wire up on the cable lead-off; or from the balloon cable by means of weak links. The last of these methods was useful for launching from extremely enclosed sites, but proved both slow and hazardous, and required at least five men.

ibid.
Enc. 34A

ibid.
Encs. 30B & 33B

Advantages of the Combined Barrage.

Air Commodore Walser pointed out considerable advantages in the combined barrage, such as the increased altitude achieved; the greater number of days on which it could be flown; (approximately 60% of the time throughout the year, as opposed to about 30 or 40% with kites alone); the improved pattern obtained in the barrage owing to the angle of the kite wire from the balloon cable lead-off; and the possibility of minimising casualties by bedding the balloons and keeping the kites flying, or vice versa, according to prevailing weather conditions. (A report on operations for the week 9th - 15th February bears out this last point. It states -

ibid.
Enc. 34B

"On several occasions the kites have been detached from the Balloon Cable when the Balloon has had to be bedded.... have been kept flying, and re-attached when the Balloon has been able to go to altitude again. Under storm conditions, with wind-speeds of 70-80 m.p.h., as many as six storm kites have been successfully flown on "legs" of 4000-7000 feet of paid-out cable. These operations have shown that a satisfactory barrage can be maintained by kites when it is quite unsafe for balloons to remain in the air....The sites used included the most difficult and enclosed in this Flight.")

ibid.
Enc. 8B.

/The cost

The cost of equipment and personnel involved in supplementing a balloon barrage with kites was economical when compared with operating tandem or L.Z. balloons, while the view that fewer balloons would be struck by lightning in a combined barrage appeared to be borne out by an incident on the 18th January when a kite cable acted as a lightning conductor, thereby saving a balloon from being struck.

ibid.
Enc.1B

Equipment

(a) Kites

Of the various experimental kites used for the combined barrage the 3-feet Cody type gave the best service, and variants manufactured from cotton and 2-ply fabric also showed promise. Mark II storm kites revealed excellent qualities on several occasions, but were less consistently reliable, and needed careful attention to rigging and trim. At an early stage the Admiralty storm kite (the Dove), twenty of which arrived in January, was found to be most unstable and considered unsuitable for land operations. Later a new storm kite was sent from Exeter, and experiments were carried out in applying cross-bracing to the 3-feet Cody and Mark II storm kites to strengthen them. By May 1941 the existing kites were still in need of further modification in rigging, for operation in really strong gales of 70 miles per hour or more, and work on these improvements continued for several months after operational flying had ceased.

ibid.
Enc.8B

(b) Fairleads

In other respects there were many defects in equipment, lack of a suitable balloon cable fairlead, for example. The early types of this attachment proved too soft, and when a long-awaited sample arrived from Exeter in March, it soon showed weaknesses and had to be returned for modification. Its place was taken by a new steel fairlead designed by Flight Lieutenant Vinton of No.13 Centre, the first of which was received at the beginning of March and appeared to be a considerable improvement on the old attachments. Five of the Vinton type were available by May, which, though considered satisfactory in principle, was not yet completely efficient, as the flying wire still showed a tendency to leave the sheave when the kites stalled at a very steep angle. It was not until the summer of 1941 that a modified fairlead was received from Exeter, which, after further alterations, proved wholly satisfactory.

ibid.
Encl.19B.
Encl.10B.

(c) Winches

The absence of a suitable winch for combined barrage operations was another obstacle, the only type available being the unreliable Ford V.8. Trials were carried out with a Wickham drum fitted to the bollard shaft of an adapted Wild winch. This proved satisfactory up to a point when flying from the balloon cable, but less practicable when flying direct, owing to the need for several central anchorages to clear the bedded balloon. Moreover, high altitude flying was limited by the incapacity of the drum to hold more than 8,000 feet of wire, and the technique of transferring from one drum to another, by means of quick connector links, was slow and dangerous. A larger drum, therefore, capable of holding 16,000-20,000 feet of flying wire, would have been an essential requirement in any further

ibid.
Encl.34B.

/development.

development. A separate winch of Morris type was also essential, but never became available in any numbers.

Repairs.

ibid. Encl.19B. The experiments also suffered from the lack of tension meters, only two of which were ever available, and of sufficient supplies of traces, flying wire, stranded cable for bridles, and other items of equipment. Much difficulty and delay was experienced throughout the trials in obtaining supplies, owing to the number of firms involved, and also in effecting repairs after breakaways and accidents. Many of the older kites, which were worn out and tended to split in the air had to be written off, and the stock was further depleted after the destruction of the kite workshop by enemy action on the 23rd April.

ibid. Encl.8B.

ibid. Encl.30B.

Barrage Control.

Another handicap to progress was the authority exercised by Barrage Control at Plymouth. Although permission was given at the start of the trials to fly kites up to 9,000 feet, it was not always possible to achieve this height owing to special restrictions in force at times, which forbade kites to be flown above the altitude of balloons, thus rendering flying from the balloons cable useless except for training purposes.

Training.

A far more serious difficulty was the question of training the personnel necessary for the combined barrage experiment. The absence of kite trades and systematic kite training put the balloon operators at a great disadvantage, and the weekly reports issued by Flight Lieutenant Hooman constantly stressed the lack of enthusiasm and response among many of the crews caused by the absence of any settled policy as to the future of kites. At intervals crews were seriously depleted by sudden postings of personnel. For example, during the third week in March six airmen, trained in kite handling, were withdrawn for duty at Liverpool, and did not return until a month later, while two of the best kite instructors were absent for many weeks at Leuchars.

ibid. Encl.19B. ibid. Encl.28A.

Recommendations, May 1941

Air Commodore Walser's first recommendation was the setting up of a training centre, preferably at Mullion, to overcome these disadvantages. (This echoed suggestions already put forward as far back as February by Flight Lieutenant Hooman of the Deputy Directorate of Scientific Research). He also advocated that all, or an agreed percentage of sites in an operational barrage should be equipped to fly balloons-cum-kites, and that these should be armed in collaboration with the Research Department at Exeter. Falmouth was suggested as a suitable barrage owing to the comparative absence of special controls, and its proximity to Mullion. (In spite of recommendations to the contrary by those concerned, only unarmed cables had been allowed for the experiments. Flight Lieutenant Hooman had suggested in February that arming should take the simplest form, consisting of a bomb and release link at the upper end of the kite flying wire).

ibid. Encl.34B.

/Adverse

Adverse Opinions on the Combined Barrage.

Neither of these proposals was accepted. At the beginning of April the Directorate of Armament Development, in a note to the Air Staff had more or less dismissed the Kite-cum-Balloon Scheme as inferior to the tandem balloon scheme or kite-assisted scheme then in process of development at Cardington. (The latter was thought likely to result in a lethal barrage up to 15,000 feet, and was accordingly proceeding on high priority). It was considered that the percentage of days in the year suitable for kite-flying would probably be small, especially at inland sites. The Senior Air Staff Officer, Balloon Command (Group Captain R.F.S. Morton) in a memorandum dated the 24th May, which was forwarded to the Director of Fighter Operations, admitted that some success had been achieved with a high altitude kite-cum-balloon barrage, but remarked on its slow operation, and also on the difficulties of arming the upper or kite-supported section of the cable. It was true that in considerable wind speeds the lowering of kites from high altitudes was slow as compared with hauling-down balloons, and that it was often impossible to exceed a speed of 200 feet a minute. In his opinion the kite-assisted cable appeared to offer the greatest scope for the use of kites, and it was hoped that the kite might be instrumental in lifting a 10-ton cable to an acceptable operational height in order to act as a counter-measure to the anti-balloon barrage devices being fitted to certain enemy aircraft.

The Walser scheme, therefore, was relegated to a very low level of priority, and on the 4th June, orders were received to transfor all kite-flying gear and winches from Plymouth to Cardington. Flight Lieutenant Hooman was attached to the Balloon Development Establishment in order to clear up the general development of the scheme, and experimental work continued slowly, with many delays, until the technical equipment was perfected in principle. Blue prints were prepared and a manual of instruction drawn up. Finally, on the 10th August, the Director of Armament Development issued instructions that all work on the scheme should cease.

ibid.
Min. 39.

Kite-cum-Mark VI Balloon Scheme, May-June 1941.

B. 17704

Encl. 3A

The Kite-cum-Mark VI Balloon scheme was a very brief sideline in kite development during 1941. At the beginning of May the Director of Armament Development asked for experiments to be carried out at Cardington, parallel with the kite-assisted scheme, in combining the Walser kite system with the Mark VI balloon to produce a cheap and mobile lethal barrage. It was thought that the balloon would assist in lifting the kite clear of obstructions and enable it to be launched from enclosed sites in built-up areas. After investigation, however, no advantages were found in this idea, since on open sites the balloon had sufficient lift to raise the kite to a height at which it would meet wind higher than the surface wind, while on enclosed sites the operational difficulties would be considerable and the low cable angle would remain. Accordingly at a conference at Cardington on the 13th June, it was decided not to pursue the matter.

ibid.
Encl. 8A.

Rocket-launching device for low Kite Barrage, March-June 1943.

In March 1943, occurred another short lived attempt to make use of kites, this time in the form of a low-level barrage

/to counter

to counter enemy tip and run raids raids against coastal targets. It was suggested by the Assistant Chief of Air Staff (Operations that the Admiralty stock of kites, at that time numbering about 5,000, might be adapted for Wing Commander Wheelwright's rocket-launching device, which had been introduced into the service in August, 1942 with the object of providing an aerial for an aircraft dinghy.(1) The bombs used for the L.A.M. scheme were recommended as means of making the barrage lethal.

S.6868
Encl. 26A.

Objections to the scheme were at once raised by the Directorate of Armament Development, and the deployment of Mark VI balloons was put forward as a more useful suggestion, while the Admiralty, though willing to release twenty kites for trials, also considered the proposal unsound. Wing Commander Wheelwright, however, contrived to press his case, brushing aside difficulties, and asked for a small development contract, adding in support of his scheme that the rocket-launched kite barrage might also serve to protect aircraft carriers against low level attack.

ibid.
Encl. 25A.

Encl. 24A.

Encl. 30B.

In June the matter was again taken up with the Ministry of Aircraft Production, who stated that the Wheelwright device was still under development and so far unsatisfactory. There was no operational requirement for a rocket-launched kite on surface craft, as kites for this purpose had been superseded by balloons. It was agreed that the project would be a long term development, needing considerable modifications, training facilities, extensive launching-sites, and a power winch for each kite. In view of the time and equipment involved it was recommended that the scheme should be discontinued.

ibid.
Min. 31.

/SECTION 13.

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(1) W/Cdr. Wheelwright's original scheme for launching kites by means of rockets was officially submitted on the 28th April 1939, and found to require extensive research and experimental work. At that time the simple method of using small balloons to assist in launching kites appeared more promising.

S.41840
Encl. 101A.

SECTION 13

VERY LOW ALTITUDE BALLOONS

S.5476
Encl.1A.
8/7/40.

In July, 1940, the Director of Home Operations informed the Air Officer Commanding-in-Chief, Fighter Command, that experiments conducted by the Admiralty to produce a Very Low Altitude balloon had proved successful. Two hundred of the balloons had been ordered for operational trials and if favourable results were obtained it was intended to use them for the prevention of minelaying in narrow estuaries and for the protection of small vital points, such as aircraft factories, against low-flying attack.

DESTROYED.
S.62602
Encl.13A.
10/7/40.

The V.L.A. balloon had a capacity of 1,240 cubic feet and had no ballonet or valve, the gas expansion being controlled by external rubber cords. It was flown from light 15 gauge piano wire and was designed to reach an altitude of between 1,000 and 2,000 feet. Balloon Command was to be instructed to carry out operational trials of the new balloon in the Thames estuary and at Cardington.

S.5476
Encl.5A.
14/7/40.

Policy and Production

ibid.
Encl.10A.
25/7/40.

The Air Staff had decided that if the trials were successful the balloons would be used for the anti-minelaying barrages which had been approved at the 17th meeting of the Deputy Chiefs of Staff held on 12th July, 1940. These were to be situated at :-

Portsmouth	Liverpool
Poole	Milford Haven
Portland	Barrow
Plymouth	Humber
Falmouth	Hartlepool
Bristol Channel	Tyne
Swansea	Blyth

DESTROYED
S.62602
M.24

By August the trials were sufficiently far advanced for the Director of Home Operations to inform the Deputy Chief of the Air Staff that

> "We feel that the V.L.A. balloon has now reached a stage of development when we can expand its employment in our balloon defence organisation".

He considered that only one airman would be required to maintain each V.L.A. balloon instead of the ten needed for each L.Z. Balloon, and therefore a considerable saving in man-power would be effected. The present requirements for the new type of balloons were as follows :-

Anti-minelaying requirement	= 226
200% Reserve	= 452
Admiralty requirement for ships	= 400
200% reserve	= 800
	1,878

Orders for 670 V.L.A. balloons had already been placed. Authority was, therefore, now sought to order a further 1,330 to bring the total to 2,000. He also required

/authority

to order 1,330 sets of ancillary balloon equipment and, as it was estimated that one small winch(1) would suffice for every four balloons, he wished to order 73 winches.(2)

ibid.
M.25.

The Deputy Chief of the Air Staff approved these proposals and production commenced. But while the Air Staff was satisfied with the V.L.A. balloon, the Air Officer Commanding, Balloon

ibid.
Encl.31A.
8/8/40.

Command was not. On the 8th August he pointed out that the balloon was still in the experimental stage and he felt that to prevent mine-laying it was necessary for a balloon barrage to fly at 2,000 feet. To reach this altitude the gas capacity of the V.L.A. balloon would have to be raised to about 1,800 cubic feet. He also considered that the balloons were too fragile and had asked the Balloon Development Establishment at Cardington to produce a more robust balloon withgreater static lift. Neither did the Air Officer Commanding share the view of the Director of Home Operations that a saving in manpower wouldbe effected, and he made it clear that in cases of barrages subject to control, balloons would have to be flown from barges and not from buoys, and complete crews would have to be t

ibid
Encl.36A
22/8/40

retained. On the other hand where there were no controls involved he though that one winch to every ten or twelve balloons would be enough. The Air Staff took note of the views

Encl.45A
28/8/40.

of the Air Officer Commanding and two of the firms manufacturing V.L.A. balloons were instructed to make a stronger and larger balloon in accordance with prepared designs and specifications.

S.5476
Encl.30A
6/9/40.

A month later the general policy and organisation problems connected with V.L.A. balloons again came under discussion. By this time a total of 5,000 were on order, contracts having been placed to allow for the production of 100 balloons a week.

In addition to those required for the protection of estuaries and ships, the Port Defence Committee had asked for a barrage of twenty-four V.L.A. balloons at Alexandria. While it was considered that the ordering of 5,000 V.L.A. balloons was justified, it was decided that all production the cubic capacity of those in production should be increased from 1,200 cubic feet to one of 1,800 cubic feet as recommended by the Air Officer Commanding, Balloon Command. It was also decided to order a further 27 winches for use in Eygpt, making a total of 100 in all. As some time would elapse before power winches were forthcoming, wooden hand winches were to be used temporarily.

Armament

In the meantime, the problem of arming the V.L.A. balloon had been solved by the Deputy Director of Scientific Research (Mr. B. Lockspeiser) who, in order to simplify equipment for waterborne sites, had devised a scheme whereby a bomb and firing link were carried at the upper end of the cable, the lower end being fastened to the buoy. In operation, when the firing link out the cable the bomb was drawn down to the wing of the impacting aircraft by the pull exerted from the buoy. Whilst this scheme was likely to prove effective against minelaying aircraft flying at a low speed, another form of armament had been designed for use in V.L.A. land barrages. Aircraft flying overland would, of course, fly at much greater speeds and it was therefore proposed to fix

/two firing

(1) The Admiralty provided their own winches.

(2) Including 30% reserve.

two firing links to the cable. A bomb and firing link were fixed to the upper end of the cable as before and a firing link and parachute also attached to the lower end. Thus on impact the cable would be broken in two places and the bomb drawn on to the wing of the aircraft by the pull of the parachute.

The Employment of V.L.A. Balloons

ibid.
Encl.42A
6/12/40.

In December, 1940, the Air Staff enunciated the policy that was to be followed in the use of the V.L.A. balloons. While this balloon with its limited operational ceiling would not have the same protective value as an L.Z. balloon, it should prove adequate in the majority of cases especially during the winter months when the main daylight risk was the single cloud-flying enemy bomber. There were at this time some sixteen aircraft factories of the first importance protected by L.Z. balloons, seven of which were isolated and away from large barrages.(1) While it was not the intention that all L.Z. balloons should be removed and V.L.A. balloons substituted, it was proposed that two V.L.A. balloons should replace one L.Z. balloon up to the scale of 60%, the L.Z. balloons thrown up being used to strengthen existing L.Z. barrages. The shortage of power winches would prove a difficulty; but this was to be overcome temporarily by a slight modification to the L.Z. winches until V.L.A. power winches became available. In any case one winch could serve several V.L.A. balloons. The total number of V.L.A. balloons required for aircraft factories, on a scale of 60%, amounted to 204. Due to an insufficiency of equipment these would have to be supplied from the balloons originally intended for anti-minelaying barrages, as those allocated to the Admiralty were all required for ships and the twenty-four detailed for Alexandria had already been despatched. If a delay was accepted in the deployment of the full anti-minelaying barrages, it would be practicable to provide protection for the major anti-minelaying areas (2) and also for the aircraft factories in a comparatively short time, the full programme to be completed by April, 1941.

S.5476
Encl.47A.
12/12/40.

This statement of policy called forth a great deal of criticism from those who were to implement it. Moreover, it would not be possible to complete it by the date required, as it was already clear that the deliveries of Mark VI balloons, as they now became known, would fall short of the minimum required.

On the 12th December, 1940, the Director General of Equipment informed Balloon Command that no Mark VI power winches were available for the balloons already supplied and he suggested that hand winches should be used instead.

ibid.
Encl.50A.)
Encl.54A.)
24/12/40.

The Air Officer Commanding, Balloon Command, rejoined that hand winches were not suitable for use in aircraft factory barrages, because these were subject to controls, the balloons having to be raised and lowered rapidly to facilitate the taking off and landi ng of aircraft. To haul a balloon down by hand winch from 2,000 feet would take

/forty minutes

(1) Hawkers, Langley
Hawkers and Vickers, Brooklands
Gloster, Brockworth
Bristol, Filton
Westland, Yeovil
Accrington

(2) The Clyde Barry
Liverpool The Thames estuary.

forty minutes - a period which operationally was unacceptable. Neither did he consider it feasible the Air Staff's suggestion that modified L.Z. winches should be used, for "the shortage of Wild winches is the only reason why the full L.Z. barrage is not flying." Finally, he did not now consider that it would be possible to operate several Mark VI balloons from one winch and he recommended that for provisioning purposes the requirements of winches should be regarded on the basis of one winch for each two balloons.(1)

ibid. Encl.59A. 5/1/41.

Meanwhile, as no power winches were available the Air Officer Commanding decided to fly the Mark VI balloons, which were undergoing operational trials at Weybridge, from Admiralty type hand winches which "while not suitable for use in aircraft factories", were considerably better than the alternative wooden hand winches. This decision was reached with reluctance, and was only made practicable by the introduction in the barrage of a permanent lane, through which aircraft could take off and land, and which made it unnecessary for controls to be exercised for this purpose.

The Mark VI Balloon Policy Changed

ibid. Encl.86A. 2/3/41.

In March, 1941, the Air Officer Commanding, Balloon Command, (now Air Marshal Sir Leslie Gossage) pointed out that the enemy had recently dropped mines in the Thames estuary from a height of 3,250 feet. This was very much higher than the ceiling of the Mark VI balloon. Moreover, to protect estuaries adequately balloons had to be sited either side of the swept channels so that they were accessible to servicing craft. This was difficult enough when balloons were flying from craft , but to service Mark VI balloons flying from buoys would, in rough weather, be an extremely hazardous undertaking.

Taking these considerations into account Air Marshal Gossage recommended that the use of Mark VI balloons for anti-minelaying purposes should be re-considered, and their use limited to:-

> "Ports, harbours, or esturaries where the navigable channel was so narrow that enemy aircraft would have to fly very low to lay their mines accurately in it, or
>
> Where balloons could be sited on land."

ibid. Encl.89A. 5/3/41.

The Air Ministry accepted those recommendations and invited the Admiralty to re-consider its requirements. In the meantime, Balloon Command were instructed not to deploy the Mark VI anti-minelaying barrages, but to use the balloons allocated for this purpose to strengthen the barrages for which there were not sufficient L.Z. balloons.(2) The barrages which the Air Staff considered should be strengthened were as follows:-

/Manchester

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(1) There were three types of winches which could be used with Mark VI balloon:-

The Wickham power winch (static)
The Ford power winch (static)
The Morris winch (mobile)

Balloon Command favoured the last on account of its mobility.

(2) The final abandonment of the Mark VI anti-minelaying barrage was approved at the 40th meeting of the Chiefs of Staff (Anti-Aircraft) Sub-Committee, although one such barrage was established in Belfast Lough - see pp.275-276.

Manchester	32
Falmouth	4
Portsmouth	16
Newcastle	16
Ardeer	8
	76

ibid.
Encl.106B.

The Chiefs of Staff (Anti-Aircraft) Sub-Committee approved this plan in principle, but the Fighter Command representative (Lieutenant Colonel H.G. Burlton), pointed out that the experiments that were being carried out Weybridge had indicated that it was not practicable to substitute two Mark VI balloons for one L.Z. balloon as the different cables quickly became entangled.

AIR/14/240/4/146
~~F8/8.22166~~
Encl.56A.
16/5/41.

A further note of warning in this connection was now sounded by Air Marshal Gossage who, in addition to informing the Air Officer Commanding-in-Chief, Fighter Command of this problem, stated that the Weybridge trials had convinced him of the necessity for each balloon to have its own winch in controlled barrages. Thus, it became obvious that the scheme for the substitution of Mark VI balloons for L.Z. balloons in aircraft factory barrages, or in any other land barrage for that matter, would also have to be abandoned and on the 10th June, 1941, the Chiefs of Staff (Anti-Aircraft) Sub-Committee approving this decision signed the death warrant of the scheme. But the Mark VI balloon itself was by no means dead. On the contrary, it was ultimately to triumphover its bigger brother both in numbers and in the variety of its use.

ibid.
Encl.70A.
17/6/41.

CS.8979.
Encl.14A.

Mark VI Balloons Flying from Merchant Vessels

For some time the Admiralty had used kites for the protection of merchant ships and certain ships of the Royal Navy. This form of defence was not successful, the kites being unreliable in strong wind, and their lethal value doubtful. It was not surprising therefore when, in April, 1941, the Admiralty informed the Air Ministry that they proposed to substitute the Mark VI balloon for kites on coastal and North Atlantic merchant shipping.

A joint Admiralty and Air Ministry note was prepared therefore, for submission to the Chiefs of Staff (Anti-Aircraft) Sub-Committee.

It was estimated that 850 Mark VI balloons would be required in the first instance. If these were to be brought into action sufficiently rapidly to play an effective part in the battle of the Atlantic it would be necessary to divert hydrogen and other maintenance resources from the static barrages. The Admiralty and Air Ministry had concluded that by depleting the land barrages of 180 L.Z. balloons,(1) sufficient resources would be thrown up for the maintenance of the ship-borne balloons. This was not as serious as it appeared, for in point of fact it was thought unnecessary to cease flying this number of balloons, but to accept the risk of being unable to replace them if casualties occurred; however, any extension of static barrages would have to be suspended until the ship-borne balloons were provided.

/The Chiefs

(1) This represented 8.4% of the existing defences.

C.O.S. (A.A.) Committee (41) 252. 22/4/41.

The Chiefs of Staff (Anti-Aircraft) Committee considered the joint note on 22nd April, 1941, and agreed with the proposals, stating in its conclusions that the reduction in balloon defences was a legitimate risk as it was preferable to send balloons to sea rather than Bofors guns. Taking into account the interference which balloons caused to our own aircraft, the Committee considered the existing scale of balloon defences, without further extensions, could be accepted with equanimity.

CS.8979 Encl.19A. 16/4/41.

Meanwhile, an Admiralty conference had been held to discuss the supply and servicing of Mark VI balloons on merchant ships. The Admiralty considered that all ocean going ships should be equipped with balloons, giving first priority to vessels on the North Atlantic route, and had prepared a list of ports at which an organisation for the provision and servicing of balloons should be established. Balloons would be inflated at the quayside and a stock of hydrogen cylinders supplied to ocean-going but not to coastal vessels. Balloon Command would be responsible for providing and servicing the balloons, and for ancillary equipment, hydrogen and cylinders, while the Navy would supply the winches and cable. The balloons would be operated by the ships crews.

ibid. Encl.49A. 8/7/41.

The Admiralty policy of equipping all ships with balloon protection involved a much greater number of balloons than had been originally suggested. The intention was that "all ocean-going ships in convoy should leave this country with an inflated balloon and the necessary cylinders of gas for re-inflating a balloon when they reach the danger zone on the homeward voyage." This plan would bring some 3,000 ocean-going ships under balloon protection.

ibid. Encl.50A. 15/7/41.

Confronted with this ambitious proposal, the Air Ministry asked the Admiralty how it was proposed to carry out this extended programme and pointed out that the whole matter depended on what equipment could be made available. In

ibid. Encl.54A. 28/7/41.

reply, the Admiralty forwarded details of the number of ships it was hoped to equip with balloons during the ensuing nine months. During that time it was intended to provide 700 coastal ships and 2,500 ocean-going ships with balloons, the latter being fitted with six hydrogen cylinders each for re-inflation of the balloon on the return voyage.

ibid. Encl.61B.

When the implications of this policy were examined it was estimated that a total of 27,800 hydrogen cylinders would be needed. This number provided a stock of six hydrogen cylinders for 3,000 ocean-going ships, and allowed for the initial inflation of some 1,450 balloons a month(1) and a reserve for ships which did not remain long enough in port for their hydrogen cylinders to be re-filled; the inflation of balloons on 700 coastal ships was also included. This figure greatly exceeded the number of cylinders which could be supplied from the static barrages. Production might be increased but only to the detriment of the manufacture of oxygen cylinders. Enough hydrogen was available for the scheme and it was estimated that 400 trailers and 124 prime movers would be required to transport hydrogen from factories to the ports. Balloons too were available but the whole scheme depended upon the provision of hydrogen cylinders.

/This problem

(1) It was estimated that 1,450 ocean-going ships would pass through British ports each month.

ibid.
Encl.74A.
24/10/41.

This problem was swept aside, however, when on the 24th October, a detailed plan by which the 3,000 ocean-going ships involved would be equipped by September, 1942, was considered by the Air Ministry and the Admiralty and it was learned that if cylinder production remained at its present level of 3,000 a month and all the cylinders were allocated to the Admiralty, the programme could be completed and all equipment provided out of normal resources without interfering with existing static barrages or overseas requirements.

ibid.
Encl.77A.

The plan was submitted to the Deputy Chief of the Air Staff and received his approval and the Admiralty were informed that the Air Council were satisfied that the scheme was practicable from the technical point of view. The Admiralty were asked, however, to examine it from the operational side having regard to the great cost and effort involved in its completion.

S.73688
Encl.10A.
ibid.
Encl.17A.

But when informed in a subsequent letter that arrangements had been made for the equipment of all ocean-going ships with two Mark VI balloons and six hydrogen cylinders the Admiralty changed its policy, and on the 8th December, 1941, stated that in view of the practical cessation of attack on ocean-going shipping by long-range bombers it was not proposed to proceed any further with the complete project. It was intended, however, that outward bound ocean-going vessels and coastal ships should fly balloons which would be deflated at longitude 8 degrees west. No provision was made for the return voyage. The revised scheme involved only 5,400 balloons, including wastage allowance, against the previous total of 17,100 and saved 21,000 hydrogen cylinders in addition to the equipment for inflating balloons on 3,000 ships.

ibid.
Encl.48A.
5/3/42.
CS.8979
Encl.117A.

Restricted entirely to coastal waters as the danger of enemy attacks on shipping diminished, balloons continued to be flown from merchant ships until the 13th November, 1944, when the Admiralty issued a signal to the effect that it had been decided to discontinue the use of balloons for the defence of naval and merchant ships in all theatres of war.

Ihle.
Trade, Tra-
ffic, Traffic

Triple Alliance was swept into history, shortly, when on the 24th December, a Declaration came [illegible] which the 3,000 accumulating obligations incurred would be outlawed by September, 1954, were considered by the [illegible] and the Admiralty and it was learned that a [illegible] production resulted in the present level of 3,000 a month and all the overtones necessitated in the Admiralty. The programme could be completed and all equipment provided out of normal resources without interfering with existing service personnel or overseas requirements.

Ludgate, Lud-
gard, Lydia.

The plan was submitted by the Deputy Chief of the Air Staff, and received his approval and the industry were informed that the Air Council were notified that by scheme was practicable from the technical points of view. The Admiralty were asked, however, to examine it from the operational and having replied as the proof and effort involved in its completion.

Pur, Purdy,
Purl, Pyle,
Pyle, Pyle,
Pyle, Pyle.

But when informed in a subsequent letter that consumption had been reduced from 4½ gallons to 4 gallons per hour on the 6th December, 1951, the Admiralty changed its policy, and on the 6th December, 1951, stated that in view of the practical operation of diesel on current ship-building by Ministry-owned yards it was not proposed to proceed any further with the original proposal. It was intended, however, that current Naval construction and conversion should be diesel engined by normal and possible [illegible] Ministry building yards [illegible] at Longbridge Deverill, Wilts. No explanation was given for this change of policy. The revised scheme envisaged 2,000 [illegible], including building [illegible] the provision [illegible] of 17,100 and saving 21,000 horsepower [illegible] in addition to the equivalent for [illegible] 2,000 ships.

Shuttle.
Shuttle, Shy,
Sly, Sly,
Sly, Sly,
Syd, Sly.

Shepherd undertook to consult writers in His Grace's of many varieties on shipping claims. Mr Soame Dewhurst to be flown from Aerobase Alpha (Hill 413, Elm Plain, [illegible] the Admiralty Panel is signed to the effect that [illegible] to Sir Clifford [illegible] Flight of Royal and Norfolk ships in 3rd Division of war,

SECTION 14.

SHORE SERVICING STATIONS

As a result of the successful trials of the Mark VI or Balloon(1), the Admiralty, during August, 1940, informed the Air Ministry that it was intended to use this type of balloon on destroyers as an alternative to kites, and in minesweepers where kites could not be satisfactorily flown. The first hundred balloons were to be distributed between three ports only, namely, Portsmouth, Devonport and Sheerness.

S/5476
Encl. 12A.
7/8/40.

Admiralty Proposals.

In order to avoid the setting up of a large independent organisation and the training of special personnel, the Admiralty asked the Air Ministry to undertake the maintenance of these balloons and the supply of the necessary hydrogen.

When further supplies of balloons became available, it was intended that they should be distributed between Harwich, Humber, Tyne and Forth, where similar servicing arrangements would be required.

ibid.
Encl. 16A.
19/8/40

A copy of this letter was sent to Balloon Command, who were requested to make the necessary arrangements to undertake the maintenance of balloons ashore and supply of hydrogen.

ibid.
Encl. 18A.
23/8/40.

In reply Headquarters Balloon Command, requested that a conference be called in order that the magnitude of this commitment might be appreciated and the division of responsibility drawn between the Royal Navy and the Royal Air Force in this respect clearly defined. Such a conference was suggested as a result of conversations with the Admiralty, when it was understood that the commitment was likely to increase until a total of 1,000 balloons were being serviced each week, distributed between some seven or eight different ports.

Whilst wishing to be of every assistance to the Admiralty in this matter, Balloon Command pointed out that a maintenance service on this scale could not be carried out without organisation and increases in establishments; consideration would also have to be given to the supply of hydrogen in sufficient quantities and its transportation to the ports where servicing was to be undertaken.

ibid.
Encl. 30A.
6/9/40.

A conference was duly held on the 6th September, when the Admiralty representatives estimated that their initial equipment requirements, together with reserves, were represented by an overall figure of four balloons per ship, and they visualised equipping 250 vessels in the first instance. This gave a total Admiralty requirement of 1,000 balloons. An initial Air Ministry estimate, made on behalf of the Admiralty, had provided for a total of 1,200 Mark VI balloons, which would be adequate to meet their requirements and make some provision for further demands.

/With regard

(1) See Part II, Sect. 13.

With regard to the organisation of these Shore Service Stations, the naval representatives said that so far as manning was concerned, it was proposed that the balloons should be based and maintained at certain ports round the coast and they hoped the handling of balloons, while on shore, would be undertaken by Balloon Command.

This was an additional commitment which the Air Ministry were quite prepared to accept, provided the necessary personnel and equipment could be provided. There was also another important proviso - that the number of balloons maintained at any one base remained substantially constant.

It was not expected that any servicing of the balloons would be carried out while on board ship, but it was proposed that two naval ratings in each ship should be trained in the elementary handling of balloons. Balloon Command agreed to provide the necessary training facilities at the nearest Balloon Centre to the ports concerned.

The Air Officer Commanding Balloon Command (Air Vice-Marshal O.T. Boyd) raised the question of hydrogen supply as it affected ship-borne balloons and suggested that the Admiralty should experiment with a mixture of hydrogen and coal gas. These ship-borne balloons, however, would have to remain at altitude for three or four days and would not be serviced until the ship returned to port. For this reason, they would require a high content of hydrogen purity on embarkation, and plenty of surplus lift.

On the 20th September, 1940, instructions were issued by Headquarters, Balloon Command to all Groups to initiate enquiries in regard to the provision of accommodation for the shore maintenance of the Admiralty Mark VI balloons.

An outstanding feature of the replies received was the fact that in no case had the local naval authorities been informed of the scheme. This, of course, was speedily rectified by the Admiralty. The main difficulty was in finding accommodation suitable for housing twenty-five inflated balloons simultaneously, which required a floor space of some 15,000 square feet, with a 16-ft. head clearance, a type of accommodation always in great demand in docks and wharves.

AHB/IID/34/5/8(A).
~~KBC/50680~~
~~Part I.~~
Enc.17A.
18/11/40.

This problem proved so difficult that an alternative instruction was issued, whereby permission was given for the balloons to be bedded down in the open under nets. Emphasis was laid on the fact that the whole scheme was primarily a matter of naval interest and that local naval authorities were responsible for the availability of accommodation. However, this proved impossible as ports under naval control were very congested, so the arrangements for the accommodation required became an air force commitment.

ibid.
Enc.19A.
12/11/40.

Headquarters, No.32 Group, on the 17th November, received instructions to commence the operation of a Shore Service Station at Portsmouth for the inflation and delivery to the Navy of Mark VI balloons provided by them, and for the subsequent maintenance of these balloons.

An increase in the establishment of No.932 Squadron was requested for this purpose, by the addition of fourteen airmen and one ton tender.(1)

/In addition,

(1) 1 Sergt. 1 Corporal and 10 aircraftmen (Balloon Operators) 1 Driver (MT) and Equipment Assistant.

In addition, four W.A.A.F. balloon fabric workers were added to the establishment of No.12 Balloon Centre, with the annotation "For Admiralty V.L.A. repair".

ibid. Encl.33A. Servicing operations commenced at Portsmouth on the 26th November, 1940, and at the same time, preparations were in hand for the setting up of further servicing stations at other ports.

ibid. Encl.34A. 28/11/40. At the end of November, the Admiralty notified Headquarters, Balloon Command of the following altered locations and priority of commencement of Shore Service Stations:-

Portsmouth	Complete and ready
Sheerness	To be ready by approx. 1/12/40
Harwich	"
Yarmouth	Date not yet decided
Plymouth	To be ready by approx. 31/12/40
Grimsby	"
Firth of Forth	"
Newcastle	Not yet confirmed.

ibid. Encl.25B. 17/11/40 At this time, twenty small barrages of ten Mark VI balloons each were projected, mainly for the protection of ports; of these, that at Greenock was already deployed, while thirteen more were authorised. Their deployment, at the following locations in order of priority depended solely on the balloons and ancillary equipment being available.

Port	Squadron	I.E.
Greenock	No.946	10
Langley	No.956	8
Methil	No.948	10
Portsmouth	No.932	10
Humber		10
Tyne		10
Medway		10
Plymouth		10
Hartlepool)		10
Middlesbrough)		20
Blyth	No.936	10
Portland	No.930	10
Barrow		10
Poole	No.930	10
Harwich	No.928	10

ibid. Encl.25C 17.11.40.

Projected, but not finally agreed upon at this time were:-

Falmouth	No.959	10
Belfast	No.968	10
Milford Haven	No.962	10
Bristol Channel	No.958	10
Liverpool		10

Division of Responsibility

ibid. Encl.56A 25.12.40. In view of the projected increase in the number of Mark VI balloons deployed by both the Royal Air Force and the Royal Navy, Headquarters, Balloon Command consider it desirable, on the 25th December, 1940, to clarify the responsibility of Balloon Command in the matter.

/After

After mentioning the responsibility of Balloon Command for the operation and deployment of Mark VI anti-minelaying barrages, the letter continued :-

> "The above has nothing to do with R.A.F. Shore Service Stations for Admiralty Mark VI balloons. The local naval liaison officers who have been appointed to deal with this matter are concerned only with all matters in connection with H.M. Ships, and possibly later, merchant ships, with Mark VI balloons.
>
> It is not intended that these balloons should operate as a protective barrage while the ships are in port, and the function of the R.A.F. Shore Service Station is to service and inflate these balloons for the Admiralty, when handed over by them to the R.A.F. at the quayside."

As there appeared to be some confusion and lack of clarity of though by the executive Royal Air Force officers responsible for the maintenance of the Admiralty balloons when on shore, Groups were instructed to inform lower formations of this policy and of the responsibility of the local naval liaison officers concerned in this matter.

On the 9th January, 1941, a conference was held to discuss the detailed division of responsibility between the Admiralty and Air Ministry with regard to Shore Service Stations. This conference was attended by representatives from the Organisation, Equipment and Accountant branches of Headquarters, Balloon Command, by a representative of the Kite and Balloon Section of the Admiralty and by the naval liaison officer at Headquarters, Balloon Command.

ibid.
Encl.69B
9.1.41.

Reference was made to the conference held at the Air Ministry on the 6th September, 1940, when it was agreed that the Admiralty would supply their own Balloons and equipment to the ships, these balloons having previously been supplied to the Admiralty from Air Ministry resources.

The Admiralty representative said that confusion had arisen because the balloons and equipment for use in the ships had been supplied by the Air Ministry direct to balloon units, who had taken them on charge and were in doubt as to the accounting action necessary when the equipment was handed over to the ships.

After discussion it was agreed that :-

(i) The Admiralty would request the Air Ministry to dispatch all balloons and equipment required for use in ships to the Admiralty K.B. Section, Tring, and to vouch such equipment to that section.

(ii) The K.B. Section, Tring, would distribute the equipment to the Port Kite and Balloon Officers, who had been appointed to supervise the equipping of ships with balloons, etc., and for liaison duties between Royal Air Force Shore Service Stations and the local naval authorities.

(iii) The Port Kite and Balloon Officer would be responsible for supplying the Shore Service Station with all equipment required to be placed on board ships.

/(iv)

(iv) The Royal Air Force would undertake repairs to the balloons issued to ships. Minor repairs might be carried out by the Shore Servicing detachment, but major repairs would necessitate the balloons being sent to the nearest Balloon Centre.

It was also laid down that Balloon Centres would take steps to ensure that only repaired naval balloons were returned to the Navy, and that naval balloons would not, under any circumstances, be used by the Royal Air Force. All naval balloons were therefore to be marked with the letters "R.N." on each side.

Supply of Balloons to Naval Ships from Barges

ibid. 71A 19.1.41. A meeting was held on the 30th December, 1940, by the naval authorities at Portsmouth, to discuss the fitting and maintenance of Mark VI balloons on destroyers and minesweepers. Two representatives of No.932 Squadron, Portsmouth attended this meeting and copies of the minutes were forwarded to Headquarters, Balloon Command in due course.

In view of the possibility of minelaying in the Portsmouth approaches and subsequent enemy air attack on minesweepers to prevent clearance of the channels, it was considered desirable to equip the Portsmouth minesweepers with balloons, if it were practicable.

In order to provide for the minimum requirements of maintenance and to avoid waste of time in embarking and disembarking balloons, it was considered essential that there should be a sub-depot for balloons at a berth where trawlers could go alongside at all states of the tide. As no space was available for such a berth in the dockyard, the question of using barges was discussed.

The suggestion that minesweepers should be fed from moored barges implied that the Royal Air Force would be responsible for the transfer of balloons to the barges, in direct opposition to the policy laid down by Balloon Command to the effect that the responsibility of the Royal Air Force ceased upon the balloons becoming shipborne.

Furthermore, at this time, the Royal Air Force had only been required to maintain balloons for channel convoy. If it was intended to fly balloons from such vessels as minesweepers and destroyers, it was likely to develop into a considerable commitment.

Headquarters, No. 32 Group, therefore, requested that the policy be clearly defined, so that the Naval authorities at Portsmouth could be informed as to how far the co-operation of the Royal Air Force in the flying of balloons from H.M. ships would extend.

ibid. Encl.72A. 22.1.41. Headquarters, Balloon Command wrote to the Admiralty stating that they wished to make it quite clear that the responsibility of the Royal Air Force for any Mark VI balloons flown from Naval vessels began on receiving the balloons at the quayside for servicing purposes. Any arrangements that might be suggested for placing the balloons at the quayside would be an Admiralty responsibility.

ibid. Encl.73A. 30.1.41. In reply, the Admiralty confirmed the original arrangements but stated that the essence of these arrangements was that the balloons required no maintenance afloat, but only

/skilled

skilled servicing ashore; thereby relieving the Admiralty of the necessity of training special personnel for balloon handling and servicing.

It had, however, been overlooked that skilled handling would be necessary in the naval servicing craft and it was requested, therefore, that the original arrangements be modified. It was proposed that, whilst the working of the boat would be carried out by naval ratings, Air Force personnel should be embarked in the boat to take over a balloon from the ship and transfer another in its place. In the majority of cases, where there was only one servicing boat, no balloons were being handled ashore except when the boat was alongside, and it was pointed out that no increase in Air Force personnel would, therefore, appear necessary.

ibid. Encl. 74A. 5/2/41.

The proposal was carefully considered by Headquarters, Balloon Command, who, pointed out in their reply the units administering shore service stations had already many commitments in addition to operating their own barrages and these commitments were assuming such large proportions that it was inadvisable to agree to any activity which would further increase the responsibilities of the squadrons concerned. The Admiralty were, therefore, requested to re-consider the matter, and it was suggested that a solution of their difficulties be found in the training of additional naval personnel in balloon handling.

A month later, the Air Ministry were notified by the Admiralty that arrangements to provide trained naval balloon crews had been made and that thirty-two ratings were to undergo a one week's course in balloon handling at Cardington. It was requested, however, that the necessary assistance and training be given at the ports by the Royal Air Force shore service detachments until such time as the ratings became proficient, and that the former might give temporary assistance in the servicing boats in the event of the Naval balloon crews being unduly reduced by sickness or leave.

It was further requested that at ports where moored barges were used for maintenance purposes, these barges should be treated as "quayside" from the point of view of Royal Air Force responsibility, on the understanding that the Naval servicing boat would be responsible for maintaining the necessary communication between the barges and the shore.

ibid. Encl. 107A 16/3/41 ibid. Encl. 109A 22/3/41

Headquarters, Balloon Command were asked by the Air Ministry to examine the implications involved, and to indicate whether they were prepared to accede to the request. This they agreed to do, on the understanding that the arrangement was only temporary and that communications between the moored barges and the shore were maintained by the Navy.

Increase in Establishment at Portsmouth.

ibid. Encl. 115A 3/4/41

At the beginning of April, 1941, the Admiralty requested that the establishment of the Shore Service Station at Portsmouth be doubled. Not only had the requirements at this port increased very considerably beyond those originally anticipated, but there had also been several special commitments involving the detachment of personnel, for maintenance purposes, to balloons based on Portsmouth, but temporarily attached to such ports as Newhaven, Poole and Southampton. Balloon operations at these neighbouring ports were of occasional and uncertain duration and therefore it was impossible to ask for servicing units to be permanently stationed there.

/No. 32 Group

ibid.
Encl.116A
5/4/41

No.32 Group also wrote to Headquarters, Balloon Command, stating that they had acceded to these unexpected requests in the past, owing to the urgency of operations, but that it was not proposed to continue to acquiesce unless instructions to do so were received from Command Headquarters.

Balloon Command, therefore, sought and obtained the approval of the Air Ministry to an increase in the establishment of one Sergeant, one Corporal and ten Aircraftmen (Balloon Operators) one Aircraftman (Driver M.T.) and a 3-ton tender. This increase, made it possible to detach personnel temporarily for servicing duties at neighbouring ports.

AHB/II.D/34/5/8(B)
~~ibid. Pt.II~~
Encl.52A.
26/5/41

Division of Responsibility in regard to Accommodation of Personnel.

The responsibility of the two Services in the matter of accommodation for personnel was clarified by a letter from the Admiralty to Headquarters, Balloon Command on the 23rd May, 1941, in which it was confirmed

> "....that wherever possible Royal Air Force personnel employed on the maintenance of Admiralty Mark VI balloons, will be accommodated by the Royal Air Force squadron by whom they are adminstered, but that where this squadron is too far distant to make this arrangement convenient, other arrangements will have to be made.
>
> 2. If these men cannot be accommodated as in paragraph 1 and the Royal Naval Balloon depot includes accommodation, Royal Air Force personnel will be housed with Naval personnel at the depot.
>
> 3. Where there is no accommodation as in paragraphs 1 and 2, both Naval and Royal Air Force personnel will have to be billeted. Each Service will be responsible for making the arrangements and for paying their own billets."

Position at 2nd June, 1941.

The position as regards Shore Service Stations at this time was as follows:-

Ports already established

Falmouth	Plymouth	Dartmouth	Portland
Portsmouth	Sheerness	Southend	Tilbury
Harwich	Yarmouth	Grimsby	Granton
Barry	Milford Haven	Cardiff	Swansea
	Newport	Avonmouth	

Ports ready to receive Shore Service Units.

Southampton	Sunderland	Newcastle (Tyne)
Blyth	Aberdeen	Methil

/Ports

Ports not yet ready

Middlesbrough, Hartlepool, Greenock, Liverpool	
Oban, Loch Ewe	Probably special establishments.
Cowes	A new port probably necessary here to service shipping in Cowes Roads.
Port Edgar	Necessary, in addition to Granton, if destroyers should be fitted with balloons to any great extent.

Training of Naval Personnel in Balloon Operations

ibid. Encl.111A 21.6.41.

Although it had twice been stated by Balloon Command (at meetings at the Air Ministry on 6th September, 1940, and again on 14th April, 1941) that they were prepared to undertake the training of Admiralty personnel, both service and civilian, in balloon handling, it was emphasized at a conference, to discuss this matter, held at Headquarters, Balloon Command on the 21st June, that the Admiralty did not wish Balloon Command to undertake any training commitment whatsoever for the Royal Navy.

As the Admiralty had accepted the training of ratings for this purpose, it was also decided that they should produce the two training publications necessary, i.e. a general handbook on the Mark VI Balloon for use by ratings on ships, and a technical handbook.

Extension of Scheme to Ocean-going ships

A4B/TD/34/5/8(c). ~~ibid. Pt. III~~ Encl.9A 22/7/41.

At the end of July, 1941, Groups were notified that the role of shore service stations, operating at that time to maintain balloons flown from ships engaged on duties in coastal waters, would be extended to cover some 350 ocean-going ships. Each ship would sail with one inflated balloon, one spare balloon and six full high pressure hydrogen cylinders, and shore service stations were authorised to issue six cylinders per vessel sailing overseas, on the authority of the Port Kite and Balloon or D.E.M.S. Officer.

The ports at which it was anticipated ocean-going ships might require hydrogen cylinders were as follows:-

Port	Estimate of number of ships sailing per week
Leith and/or Granton	3
Newcastle	4
Middlesbrough	3
Hull	3
Port of London	3
Cardiff, Newport, Avonmouth, Swansea	6
Liverpool	10
Glasgow	8
	40

/These instructions

AHB/IID/34/5/8(D)
~~ibid. Pt.IV.~~
Encl.127A.
24/12/41.

These instructions were, however rescinded in December, 1941. Outgoing ocean-going ships were relegated to the same category as ships in coastal waters and were to be supplied only with inflated Mark VI balloons, although the issue of six hydrogen cylinders was allowed to continue in certain cases of coastal shipping sailing round the north coast of Scotland, on the authority of the Port Kite and Balloon or D.E.M.S. Officer.

Mobile Servicing Craft

AHB/IID/34/5/8(C)
~~ibid. Pt.III~~
Encl.23A.
23/7/41.

It had been found from experience that the most economical and satisfactory method of servicing balloons on ships in a convoy anchorage was by means of a mobile servicing craft carrying balloons, equipment and hydrogen.

In July, 1941 the Admiralty, accordingly, requested Balloon Command that arrangements might be made for six airmen to be available on each of the craft to attend to the servicing of balloons; naval ratings would also be on board to supervise the transfer of balloons and to attend to lethal equipment. It was not considered that additional personnel would be required for this purpose, as the work at shore service stations would be reduced by the introduction of these craft.

Headquarters, Balloon Command agreed to the proposal and arranged that airmen, drawn from the existing personnel of the shore service stations be made available for this purpose.

Review of Responsibility

Balloon
Command
F.540
22/5/42.

During this time, an experiment conducted and recommended by the Naval Commander-in-Chief at Plymouth had been in progress at Dartmouth. This experiment led the Commander-in-Chief to recommend to the Admiralty that the shore service stations be manned by naval personnel, both male and female, instead of by airmen.

The proposal sought to vary the present division of responsibility between the Services, which was that the Royal Air Force was responsible for handing over the waterline balloons which were inflated and fit to fly, for embarkation in vessels by the Royal Navy. The Admiralty were not in favour of altering the arrangements which were clearly satisfactory, but they submitted the comments of the Commander-in-Chief to the Air Ministry, who in turn forwarded them to Headquarters, Balloon Command for comment.

In their reply, Headquarters, Balloon Command gave the following reasons why the existing arrangements were considered satisfactory:-

(a) The employment of the W.R.N.S. at all ports was impracticable and as ships passed from port to port, uniformity of servicing organization was highly desirable.

(b) Repair and modification of Mark VI balloons and technical supervision by Balloon Command of naval personnel was undesirable.

/(c)

(c) There were only 600 men employed on the fifty shore service stations round the country. As a contribution to the war effort, the saving by employing the W.R.N.S. would not offset the obvious decrease in efficiency.

(d) The principle of employing women at ports was open to question, but where women could be employed, W.A.A.F. Balloon Operators were obviously more suitable than the W.R.N.S.

(e) The shore service stations formed a valuable training ground for balloon operators for overseas Mark VI barrages.

(f) The provision of equipment would be highly complicated.

(g) The Royal Air Force would have to continue to supply hydrogen, which would involve duplication of transport at naval-manned ports.

Broadly speaking, Headquarters, Balloon Command told the Air Ministry that it was not considered politic in this case to "change horses in midstream".

Review of Establishments

Approximately one year after the commencement of operations by shore service stations, Headquarters, Balloon Command instructed all Groups to review conditions at ports administered by them.

The letter stated:-

AHB/S.D/34/5/8(E)
~~KBO/50680~~
~~Part V~~
Encl. 44A.
26/5/42.

"The establishment of personnel and mechanical transport has been of necessity fixed on an arbitrary basis without knowledge of local conditions; furthermore, operations at various ports will now have settled down and the exact commitment will be known.

The urgency necessity for the utmost economy in personnel and transport is already understood by all units and it is clear from observations at some ports that economies can be effected, both in personnel and in transport, and also that in the case of units operating more than one shore service station, some re-arrangement of personnel might be desirable.

The varying conditions at ports caused different recommendations to be made. At many stations, work had settled down and the existing establishments were found to be adequate, while at three stations in No.32 Group, reductions in personnel were recommended.

In Nos.30, 33 and 34 Groups, however, it was stated that work had increased, and additions to establishments totalling three Sergeants, thirteen Corporals and 69 Aircraftmen were requested. Where mechanical transport was concerned, requests were made in several cases for the disestablishment of 3-ton tenders, and at stations in No.34 Group, it was recommended that these vehicles be changed for 15 or 25 cwt. trucks.

Indeed, so many points were involved that, at the request of Headquarters, Balloon Command, a meeting was held at the Air Ministry on the 13th July, 1942 when the proposed changes, in both personnel and transport, at shore service stations were

/discussed

discussed and decided upon.

Suggested Re-organisation in No.34 Group

AHB/IID/34/5/8(E) ~~ibid. Part V.~~ Encl.58A. 4/7/42.

As a result of the recent review, Headquarters, No.34 Group submitted a proposal that shore service stations, under its command, should be formed into a separate entity, under the direct administration of Group Headquarters.

Although this would entail the additional establishment of a headquarters staff, the Group maintained that this would be so small as to have little or no bearing on the arguments for or against the proposal, which their view had the following advantages:-

"(a) The movement of personnel from station to station to meet the varying conditions of work would be simplified under one control.

(b) All shore service stations would come under one control, avoiding unnecessary visits, simplifying administration and procedure, and achieving economy of effort throughout all shore service stations.

(c) Liaison with the Royal Navy would be greatly simplified and would preclude possibilities of friction inevitable with multiple control.

(d) Greater efficiency would be achieved in organising repair work, and a considerable extension of these activities could be easily carried out and supervised.

(e) If, through W.A.A.F. substitution, the screening of shore service station personnel becomes necessary, the formation of this unit would simplify the operation."

ibid. ~~Part V~~ Encl.68A. 26/7/42

In reply, Headquarters, Balloon Command pointed out that the long-established Air Ministry principle in dealing with small and scattered units, similar to shore service stations, was that they should be controlled for all matters of administration and discipline by the nearest unit. The proposal to establish a separate unit for this purpose at Group Headquarters cut right across this principle, and obviously could not possibly be considered by the Air Ministry, unless very strong arguments could be presented in its favour, particularly as this change of policy would involve an increase in both personnel and transport at a time when considerable efforts were being directed to a reduction of both.

The shore service stations in No.34 Group appeared, to the Command, to present no problems different from those in any other Group, except for the stations situated north of the Firth of Forth. For the administration of these, all of which came under No.929 Squadron, one Flight Lieutenant would be added to the establishment of that Squadron.

/Flying

Flying of Mark VI Balloons from Merchant Ships.(1)

AM/CS.8979 Encl.11A. 10/4/41.

In April, Headquarters, Fighter Command received a signal from the Admiralty stating that experience with Mark VI balloons in warships had shown that they were suitable for towing by merchant ships from the existing kite fittings.

Headquarters, Fighter Command notified both the Air Ministry and Headquarters, Balloon Command of this signal and stated that discussions had been with the Admiralty on the proposal to fit Mark VI Balloons on merchant ships operating as follows:-

(i) On the East Coast - about 30 ships between Methil and Southend. A small servicing station would be required at both places.

(ii) Along the South Coast route - Sheerness to Portsmouth was already operating. Arrangements proposed the Bristol Channel to Falmouth (servicing station already established) to Dartmouth, to Portland, to Southampton. It was suggested that Dartmouth could be serviced from Plymouth. Poole and Newhaven might also be used, but a mobile servicing unit could possibly be established at Portsmouth to deal with Poole, Newhaven and possibly Portland.

(iii) On the northern route (low priority). Methil - Scapa - Oban - Greenock. The three last-named would need to be established as servicing points.

(iv) On the Atlantic route. This type of shipping only would require to carry hydrogen at sea. In order that balloons might be topped-up and flown until the vessel was beyond the reach of German aircraft and similarly serviced on the return voyage, a total of ten cylinders per ship might be required. It was estimated that 200 ships would be concerned and that initially 700 cylinders would probably suffice. Servicing of Atlantic vessels was proposed at Liverpool, Belfast, Greenock and Londonderry.

ibid. Encl.4A. 14/4/41

At a meeting held at the Air Ministry on the 14th April, 1941 to discuss these proposals, it was agreed that the servicing of Admiralty balloons should remain an Air Force responsibility, but that the personnel for handling the balloons in the ships would be provided by the Admiralty. Headquarters, Balloon Command stated that sufficient Air Force personnel were available to meet their side of the commitment, and that they would be willing to train Admiralty personnel, who were civilians and unused to balloon handling.

A further conference at which representatives of the Air Ministry and both Fighter and Balloon Commands were present, held at the Admiralty on the 16th April, 1941, to work out details of the plan for flying Mark VI balloons from merchant vessels.

ibid. Encl.19A. 16/4/41.

At this meeting, a summary of the average daily movements of ships round the British coasts was given and a list was

/submitted.

(1) See Part II, Section 13.

submitted of the ports at which it was considered that organisations for the provision and servicing of balloons should be established. This list, which is given below, included ports where shore service stations were already in operation for naval ships. Smaller ports, not listed, would be grouped under the major ports, as might be necessary, for servicing.

Ports	Daily Sailings			Boats and Crews
	HM. Ships	Merchant Ships	Total	
Tilbury		10	10	1
Southend		25	25	3
Sheerness	16		16	2
Harwich	6		6	1
Yarmouth	4		4	1
Humber	6	9	15	2
Middlesbrough		9	9	1
Hartlepool		1	1	1
Sunderland		4	4	1
Tyne	6	14	20	2
Blyth		11	11	1
Methil		21	21	2
Granton	12		12	1
Aberdeen		6	6	
Loch Ewe		10	10	1
Oban		8	8	1
Greenock		4	4	1
Liverpool		8	8	2
Milford		3	3	1
Swansea	6	1	7	1
Cardiff		1	1	1
Barry		1	1	1
Avonmouth		1	1	1
Falmouth	4	3	7	1
Plymouth	12		12	1
Dartmouth		3	3	1
Portland	4	3	7	1
Southampton		3	3	1
Portsmouth	20		20	2

It was agreed that any ships arriving at ports other than those listed should, if necessary, in the absence of topping-up or servicing facilities, haul down and deflate their balloons and land them into the care of the naval authorities. For this purpose and also for use in ocean-going ships, valises would be supplied.

The Air Ministry would supply balloons, swivels, bombs, hydrogen and cylinders, servicing equipment, hoses for topping-up, and, for ocean-going ships, one and three-way fillers, long hoses and cylinder keys. The Admiralty would provide winches and wire and would also be responsible for securing the necessary storage space and accommodation for shore servicing units at ports, and for the embarkation of balloons. Royal Air Force responsibility would end with the delivery of the balloons and equipment at the quayside. The principle of handing over balloons inflated and ready for embarkation at the quayside held good, unless congestion precluded this when arrangements would be made to transfer to ships at their anchorage.

/The Admiralty

The Admiralty accepted the responsibility for finding and manning the necessary craft for servicing work at the ports; the only port at which any difficulty was anticipated was Southend, where it might be necessary to ask the Royal Air Force to assist by loaning or transferring to the Admiralty a suitable vessel.

AHB/IID/34/5/8(E).
~~KBO/50680~~
Encl.126A
19.4.41

On the 19th April, Headquarters, Balloon Command notified all Groups of the establishment of additional shore service stations at ports for servicing balloons to be flown on naval ships, coastal vessels and ocean-going ships, proceeding to America. A list of the ports, in the anticipated order of priority, and of the Air Force parent units was as follows:-

Port	Balloon Unit	Hydrogen supplier
Tilbury) Southend)	No. 4 Balloon Centre (in liaison with No. 952 Sqdn.)	No. 4 Balloon Centre
Liverpool (for Atlantic shipping)	No. 919 Sqdn.	No. 8 Balloon Centre
Middlesbrough) Hartlepool)	No. 938 Sqdn.	No. 938 Sqdn.
Sunderland	No. 937 Sqdn.	No. 15 Balloon Centre
Tyne	No. 936 or 937 Sqdn.	"
Blyth	No. 936 Sqdn.	"
Methil	No. 948 Sqdn.	No. 948 Sqdn.
Milford	No. 962 Sqdn.	No. 21 Balloon Centre
Swansea	No. 958 Sqdn.	"
Cardiff	No. 935 Sqdn.	No. 14 Balloon Centre
Barry	No. 969 Sqdn.	"
Avonmouth	No. 927 Sqdn.	No. 11 Balloon Centre
Oban	No. 18 Balloon Centre	No. 18 Balloon Centre
Humber	No. 944 Sqdn.	No. 17 Balloon Centre
Greenock	No. 946 Sqdn.	No. 18 Balloon Centre
Dartmouth	No. 934 Sqdn.	No. 13 Balloon Centre
Portland	No. 957 Sqdn.	No. 11 Balloon Centre
Aberdeen	No. 18 Balloon Centre	No. 18 Balloon Centre

The Admiralty arranged to carry out a reconnaissance of these ports and to contact the local Air Force authorities concerned.

CS.8979
Encl.22A
26.4.41

On the 26th April, Headquarters, Balloon Command, submitted to the Air Ministry the provisional establishments required for these additional shore service stations and in a further letter to Groups stressed the importance of the new shore service stations and the speed with which they should be set up and operations begun.

ibid.
Encl.23A
27.4.41

The new units were to commence working on the provisional establishments laid down, and requests for increases or reductions in those establishments were to be made only after practical experience had been gained.

/Balloon

Balloon Liaison Officer for Canada.

ibid.
Encl.19A.
16/4/41.

At the conference held on 16th April, 1941, it had been suggested that an air force officer, with knowledge of the Mark VI balloon, should proceed to Halifax, Nova Scotia at an early date to make the necessary arrangements for a shore servicing depot there.

ibid.
Encl.24A.
3/5/41.
ibid.
Encl.32A.

On the 3rd May, this suggestion was followed by a request from the Admiralty, that Wing Commander Berryman, might be loaned to that Department for this purpose. This was agreed to by the Air Ministry, but at a conference held at the Admiralty on the 30th June, the position was altered.

~~CAB/BD/34/5/8(E).~~
~~M&S/50680~~
Encl.129B.
30/6/41.

It was now suggested that the principal object in sending Wing Commander Berryman to Canada would be to obtain supplies of cylinders, hydrogen and balloon equipment. It was pointed out that any shore servicing depots set up at Halifax or Sidney Cape Breton would only be a small scale and that it would be preferable to have junior naval kite and balloon officers in charge of these depots. It was decided, therefore, that the best plan would be for Wing Commander Berryman to lead a "foraging" mission in co-operation with the Ministry of Aircraft Production and for the servicing depots in Canada to be a naval responsibility.

The matter rested there until the 15th July, 1941, when the Air Ministry informed the Admiralty that:-

CS/8979
Encl.50A.
15/7/41.

> "....The Council note that Wing Commander Berryman is no longer required to establish the balloon servicing depot at Halifax. In view of the fact that the British Purchasing Commission is handling the question of the purchase of equipment from America, the Council consider it unnecessary for Wing Commander Berryman to proceed to either Canada or U.S.A."

ibid.
Encl.54A.
28/7/41.

The Admiralty agreed that the Services of a Royal Air Force officer were not now required in this connection, and the matter was dropped.

Liaison between Admiralty and Air Ministry.

CS/8979
Encl.24A.
3/5/41.

Also included in the Admiralty letter of the 3rd May, was the suggestion that a technical officer of the rank of Wing Commander be appointed from Balloon Command for service at the Admiralty as liaison officer. This suggestion was made on the grounds that the fitting of Mark VI balloons to merchant ships proceeding coastwise and to American ports would involve considerable organisation for maintenance purposes and required close co-operation between the Admiralty and Air Ministry.

ibid.
Encl.32A.

The Air Ministry replied that in view of the fact that balloon servicing depots at ports had been placed under the control of the various Balloon Groups who administered and supervised them, the Air Council considered that a more suitable arrangement than the appointment of a balloon liaison officer at the Admiralty would be the attachment of a further naval liaison officer to Headquarters, Balloon Command to assist in the co-ordination of the control of these detachments and to keep the Command fully informed of the movements of ships.

/The Admiralty

ibid. Encl. 7/6/41.

The Admiralty, however, did not agree with this view and on the 7th June, 1941, wrote a long letter to the Air Ministry, setting out their reasons for adhering to the view that a Royal Air Force officer was required. Among the points raised were the following:-

"....(a) Advice is required by the head of the Kite and Balloon Section, Admiralty on technical matters connected with balloons, and also on such matters as different supply procedure between the Services.

(b) Mark VI balloons are not usually flown by established balloon personnel nor are Balloon Group officers fully familiar with them, and it is, therefore, essential that a senior officer with complete technical knowledge of this type of balloon, who is also in close touch with the Admiralty should be available, at all times, to give technical advice to the ports and to assist in overcoming any difficulties which might tend to interfere with that close co-operation between the Services which is essential for the efficient working of the scheme.

(c) In many ports, shore service station personnel are located at some distance from their parent units, and this may cause Air Force administrative difficulties. It is considered that these could only be appreciated and dealt with by a senior Royal Air Force officer, who is in close touch with both Headquarters, Balloon Command and the Admiralty."

ibid. Encl. 45A. 30/6/41.

The Air Ministry finally agreed to the appointment of an officer for liaison duties in the Kite and Balloon Section, and wrote a letter to the Admiralty on the 30th June, 1941 to that effect, stating that they were taking steps to post a suitable officer.

Reductions in Shore Service Stations

During September, 1943, the Admiralty informed Balloon Command that it had been decided to reduce the balloon protection of merchant ships in certain waters. This enabled shore service stations at five ports to be disbanded immediately, and also made reductions in establishments possible at other ports.

AHB/IID/34/5/8(F)
~~KBC/50680 Part VI~~
Encl. 5A 16/9/44

Reductions continued slowly but steadily during the year, until on the 16th September, 1944 when the following signal was received from the Admiralty:-

"Balloons are no longer to be provided for ships in coastal waters of the United Kingdom or for ships bound for French, Bay or Channel ports. Where practicable, balloons are to be provided for ships proceeding to Belgian and Dutch ports."

ibid. Encl. 10A. 27/9/44

On the 27th September, a meeting was held at the Admiralty to consider whether the effort required to maintain the supply of balloons on even a small scale was justified. The maintenance of a skeleton organisation was proving increasingly difficult as the actual flying of balloons from ships was

/reduced

reduced. The view was expressed that it was unlikely that balloons would be required even on ships proceeding to Dutch and Belgian ports. Air opposition in Normandy was negligible and in view of the scale of air cover maintained, it was not considered justifiable to maintain the organisation on such a small scale. It was, therefore, recommended that the flying of balloons by ships in all Home waters should cease and that the organisation for the supply and maintenance of balloons on ships in all Home waters be closed down forthwith.

S/8979
Encl.117A

The Admiralty issued instructions on the 13th November, 1944 to the effect that it had been decided to discontinue the use of balloons for the defence of naval and merchant ships in all theatres of war, and instructions were issued by the Air Ministry to Headquarters, Balloon Command that all shore service stations were to be disbanded with effect from the 21st November, 1944.

AHB/IID/34/5/8(F)
~~KBC/50680 Pt.VI~~
Encl.25A.

/SECTION 15

SECTION 15

ANTI-CABLE DEVICES

AHB/IID/34/3/4(E)
~~HBO/S.50230/~~
INT.
Encl. 29A.

At 22.35 hours on the 7th April, 1941, an enemy aircraft approached Crewe up the main London Midland and Scottish railway line flying at a height between 500 and 1,000 feet. The Crewe balloons were flying at 3,500 feet. The aircraft entered the barrage, flew up the railway line as far as Crewe Station, and then turned half right up the Manchester line whereupon it circled and left the barrage area. Shortly afterwards it returned and dropped a number of bombs in the vicinity of the main railway junction. The aircraft then banked to starboard and flew up the Chester line where it turned to port and again attacked the railway junction. It then left the area in a south easterly direction.

Such contempt for a balloon barrage was not a normal occurrence; but this was not a normal aircraft, for a number of crews reported that it carried a fixture rather on the lines of the front bumper of a motor car attached to protect the forepart of the aircraft against the results of impacting balloon cables. Some warning that a device of this nature was in course of preparation had been gleaned from the interrogation of Prisoners of War, but no preparations had been made to combat it.

P/W reports
No.35/1941
No.165/1941

The first reaction of the Air Staff was that the appearance of the device was one of the unfortunate results of the Free Balloon Barrage.

S.7231
Encl. 38A.

> "It looks as if our forecasts of what would happen if people were allowed to go mad over balloon barrages was now being realised."

wrote the Director of Fighter Operations (Air Commodore J. Whitworth Jones) to the Vice-Chief of the Air Staff (Air Chief Marshal Sir Wilfrid Freeman).

> "One of the arguments in favour of retaining the balloon barrage as protection against low flying and medium height attacks was that the tactics of just going over the top of the balloons would be easier than developing special cable cutting devices and fitting them. The moment we put obstructions at heights much greater than 5,000 feet it would obviously become worthwhile to develop protective devices on aircraft. We have to thank Albino enthusiasts and high altitude barrage experts for this recent development in German equipment.....the conclusion would seem to be to kill Albino at once....."

ibid.
Enc. 39

Meanwhile, Fighter Command were demanding that information be given them of the action being taken to render balloon cables lethal to aircraft fitted with such protection, for

> "the value of the balloon barrage is dependent on the solution of this problem at an early date".

In the event of no adequate solution being available it was requested that a high percentage of balloon crews should be provided with Lewis guns. Guns, however, were not forthcoming because firstly, they were not available and secondly, the forthcoming substitution of airwomen for airmen on balloon sites precluded the manning of them.

/On the 29th April,

ibid. Encl.47A.

On the 29th April, a conference was held at the Ministry of Aircraft Production to discuss the problem, and it was decided that:-

(a) the Balloon Development Establishment, Cardington, should examine the possibilities of flying balloons on a very heavy cable, say of ten tons strength;

(b) the Research Department, Exeter, and the Balloon Development Establishment should consider the possibilities of:-

(i) Hanging Short Aerial Mines on the cables.

(ii) Developing the I.M.L. scheme on lower priority.

(iii) Hooks spaced at intervals on the cable.

(c) the Research Department should:-

(i) Examine the possibility of using abrasive wires (which had greatly increased sawing power) for Long Aerial Mines and carry out catapult tests.

(ii) Consider the possibilities of a number of light aerial mines coupled together.

(iii) Examine Long Aerial Mine flight film records to assess the efficacy of hooks spaced along a Mark VI balloon cable.

While these counter-measures were being examined, further bumper-fitted enemy aircraft were reported flying over various parts of the country, and during May, a Heinkel 111, so fitted, was shot down near Birmingham. The aircraft, though considerably damaged, did at least, give the scientists something to work on. The weight of the structure was estimated at 700 to 900 lbs. and its effect upon the performance of the aircraft was such that it immediately reduced the range, speed and bomb load by 15 to 20 per cent - a good indication of the respect the enemy had for balloon barrages.

THE HEAVY CABLE

The scientists met again on the 17th May at the Royal Aircraft Establishment and decided that the most promising counter-measure against bumper-fitted aircraft would be to fly a proportion of balloons each with an attachment of very heavy cable. It was reported that the Balloon Development Establishment were obtaining 7 and 10 ton cables and examining the necessary modifications to winches and other problems. Their work was to proceed on the highest priority.

Meanwhile, the Royal Aircraft Establishment was to estimate the strength of the cable required to break through the bumper:-

(a) On impact, for various positions of collisions.

(b) By static force in the optimum positions midway between support members of the bumper.

/This information

ibid. Encl.52A.

This information was not forthcoming until the 13th June, when at a priority conference held at the Balloon Development Establishment it was stated that a bumper-fitter aircraft required a load in excess of 25 tons to break it.

By August, the position had again changed and it had been ascertained that a 30 ton cable would be required. The Air Staff proposed to equip 100 per cent of the balloons with this new device but Balloon Command pointed out that the enclosed nature of a number of sites would severely limit the use of the cable and requested authority to experiment with the first 50 lengths available.

ibid. Encl.76A.

The Director of Fighter Operations agreed to this suggestion and at the same time enunciated the policy for the tactical employment of the cable. In the first place, by virtue of its weight, the height of the balloons would be limited to about 1600 feet. While this height might prevent bombing from very low flying aircraft fitted with bumpers, it would also enable standard aircraft to bomb from as low as 2,000 feet. It was desirable, therefore, that a proportion of the balloons in all barrages should be flown at their normal operational height as a deterrent to unprotected aircraft.

The Air Staff calculated that the chances of an aircraft flying through a balloon barrage and impacting a cable varied a great deal according to the size of the barrage.(1)

Balloon cables were assumed to be lethal throughout their length to unprotected aircraft, but when balloons were equipped with heavy cables they would only be lethal if a protected aircraft struck the heavy cable; as it was proposed that the heavy cables should be suspended from varying heights, and would be only 400 feet in length, the chances of destroying an aircraft were reduced by 75 per cent.

In order to afford the best possible protection, the Air Staff had decided that balloons with the heavy cable attachment should be sited close together in the immediate vicinity of the vital points they were protecting, while balloons not fitted with heavy cables should be retained at their normal operational height on the outer perimeters of the barrage. This might make it necessary to augment isolated barrages at the expense of those protecting larger areas.

ibid. Encl.81A.

Fighter Command did not agree with this latter decision, pointing out that it would make numerical demands in withdrawals from larger barrages which they could not meet without being unacceptably weakened. The Command were of the opinion that, with the limited bomber force the enemy had at his disposal on the Western front and those concentrating on shipping attacks, there was little likelihood of the enemy making large scale attacks on inland targets with bumper-fitted aircraft. They proposed, therefore, in conjunction with Balloon Command, to distribute the heavy cables available to those barrages which they considered most likely to be attacked. This would, apart from anything else, allow the crews to get operational experience in handling the cables and assist in formulating a practicable policy for the future.

ibid. Encl.97A and 97B.

The trials were carried out in September and October when some 200 sites were issued with heavy cables which were flown under all conditions. In November, the Air Officer Commanding, Balloon Command (Air Marshal Sir Leslie Gossage) reported the results. They were not impressive. The effective operation /of balloons

(1) Representative estimates for three barrages were:- London 50%, Portsmouth 20%, Langley 15%.

of balloons equipped with heavy cables was in itself a formidable task. The cable could only be used at sites where the tops of surrounding obstacles, such as houses, trees, etc., formed an angle of less than 35 degrees with the ground at the central anchorage. Neither could it be flown when ground wind speeds were over 25 miles an hour as it thrashed about in a manner likely to cause serious injuries both to the crew and to surrounding property. In dangerous lightning conditions it could not be handled without danger of electric shock to the operators. Finally, 30 minutes were required to raise the balloon to its maximum height of 1,600 feet - a length of time that operationally was unacceptable.

In view of these difficulties, Air Marshal Gossage came to the conclusion that:-

> "this temporary expedient has revealed so many limitations in operation, I consider it inadvisable that its adoption should be extended beyond the 200 balloon sites already equipped pending the arrival of better devices."

The Air Staff accepted this view and the heavy cable was abandoned. But at the same time the enemy evidently decided that the operational limitations which the bumper imposed upon their aircraft were too severe, and turned their attention to a new form of anti-cable device known as the "Kutonase" - a highly efficient cable cutter. The scientists had to think again.

THE "KUTONASE" CUTTER

S.7231
Encl.107B.

While salvaging the wreckage of a Dornier 217 which crashed on the 11th January, 1942, at Arbury, a short length of steel, 7½" long, of triangular section with a sharpened knife-edged apex and a flanged base, was found. This was the first tangible evidence of the "Kutonase" cutter. From this small piece of steel it was deduced that the triangular blade was fixed by means of rivets or screws to the foremost position of the leading edge of the mainplane both outboard and inboard of the engines, and around the nose of the cockpit on one of the frame members. To prevent any turbulence which might arise due to its position, the blade was covered with a fairing which, when it ran over the landing light in the leading edge of the port wing, was made of perspex or glass. The portion of the blade which ran round the cockpit was also covered as apparently ground crews had cut themselves when cleaning the aircraft.

The appearance of the "Kutonase" cutter resulted in a momentary effort to resuscitate the heavy cable, but this idea was promptly rejected by the Air Officer Commanding-in-Chief, Fighter Command, who ruled that

> "until there is an appreciable increase in enemy activity in balloon barrages to show that the "Kutonase" is effective against the type of wire now used,"

AHB/IID/34/4/11(A)
~~KBO/S.51253/~~
OPS.
Encl.54A.

he proposed to make no changes in the present method of operating balloon barrages. But any supporters the heavy cable might have had were lost when, on the 17th March, Air Marshal Gossage informed the Air Officer Commanding-in-Chief that

> "tests with the heavy cable as a counter to the "Kutonase" knife edge cutter have shown that it is quite ineffective, being cut almost as easily as the ordinary balloon flying cable."

G.192400

/COUNTER-MEASURES

COUNTER-MEASURES

S.7232
Encl.110A.

Strenuous efforts were immediately made to produce an effective counter-measure to the new cutter. Among the first were the Sliding Bolas and the Cordtex cable. Neither proved successful.

The Sliding Bolas consisted of a unit of about 5 feet of cable with a weight at one end. The other end of the cable was attached to the balloon cable by means of a grip which slid upwards, but not downwards; these units were fixed at intervals of approximately 40 feet. When an aircraft hit the cable, the bolas immediately below the point of impact, swung round and moved upwards until it wrapped itself round the bumper or wing of the aircraft.

The Cordtex cable was an explosive unit placed alongside the balloon cable and detonated electrically when struck by an aircraft. Although the explosion was not likely to cause much damage to the aircraft, it was considered that the moral effect on the pilot would be considerable.

To reply on a device which had only a moral effect, however, was no solution to the problem, and it was not until the 11th October, 1942 that the Director of Fighter Operations was able to inform the Air Officer Commanding-in-Chief that a possible answer to the "Kutonase" cutter had been found. This was known as the Twin Cable Bomb scheme.

THE TWIN CABLE BOMB

ibid.
Encl.135A.

This device consisted of a standard LZ barrage balloon flying on double 32 cwt. cable. The cable ran from the winch over a ground pulley up to the balloon where it ran over a balloon pulley back to a swivel attached to the ground. The cable was armed with a series of bomb units spaced at intervals of either 100 or 200 feet. The cable formed part of an electric circuit which was so arranged that when an aircraft cut the cable all the bomb units below the aircraft were fired. The distribution of bomb fragments was in the form of a cone spreading upwards from the bomb, which was designed primarily to attack self-sealing petrol tanks; the high speed of the fragments (1) combined with their shape causing uncontrollable leaks in the tanks.

With bombs spaced at 100 feet, the height of the balloon was 2,200 feet and the chances of hitting a tank with at least one fragment was 75 per cent. The blow-away speed of the balloon was 60 miles an hour.

The main disadvantage of the Twin Cable Bomb appeared to be the reduction it imposed upon the height of the balloons, but the Air Officer Commanding-in-Chief, Fighter Command, was prepared to accept this, and an order of priority for arming balloon barrages with the new armament was prepared. This was changed with such regularity, however, that no useful purpose is served by setting it out.

SB.35154
S.7231
Encl.135A.

Meanwhile, as preparations were under way to produce sets of Twin Cable Bomb equipment to undergo service trials, experiments were also being made with Mark VI balloons flying in tandem as a possible counter to the "Kutonase" cutter. This was known as the Mark VI (Type F) Barrage.

/MARK VI

(1) 3,500 feet a second.

MARK VI (TYPE F) BARRAGE

A Mark VI balloon barrage unit consists of a small balloon of 2,500 cubic feet capacity, flying at a height of 2,000 feet on 15 standard gauge piano wire.(1) Where additional height is needed, one unit may be flown above another and a height of 4,500 feet can be reached.(2) The blow-away speed of this arrangement is 50 miles an hour.

The flying wire is armed with a bomb unit at the top and a towing parachute at the bottom. These units are connected in parallel with the wire across inertia links. When an aircraft strikes the wire the inertia links part, the towing parachute is drawn out of its container and the bomb is freed from the bomb unit except for a small stabilizing parachute which remains attached to the tail of the bomb. The aircraft is straddled, therefore, by a length of wire with the towing parachute at the lower end and the bomb and stabilizer at the upper end. The towing parachute rapidly draws the wire over the wing until the bomb strikes it, detonating upon impact.

It was considered that the Mark VI balloon cable would not be cut by aircraft fitted with the "Kutonase" cutter and flying at speeds below 300 miles an hour.

COMPARISON OF MARK VI BALLOON BARRAGE AND THE TWIN CABLE BOMB SCHEME.

In December, 1942, the Deputy Director of Scientific Research (2) (Mr. Lockspeiser), Ministry of Aircraft Production, prepared a paper comparing the two latest counter-devices to the "Kutonase" cutter. The advantages and disadvantages of the two schemes were carefully set out and may be summarised as follows:-

ADVANTAGES

Mark VI Tandem Barrage

1. Equipment practically entirely of existing types in production. Except for tandem flying had passed the test of operational use.

2. Cheaper per site in both material and personnel than the Twin Cable Bomb. Rubber required per site 50 lbs. (solo) or 100 lbs. (tandem) against 330 lbs. for the LZ balloon.

3. Greater operational height than the Twin Cable Bomb Scheme.

Twin Cable Bomb Scheme.

1. Should be able to deal with all probable cutter developments, assuming that fairing development would be in the direction of increased penetrability.

2. Effective anywhere along an aircraft span, including propeller impacts.

3. Speed of operation and variation of barrage height consistent with standard of flying policy.

4. Acceptable blow-away speed.

5. The balloon could be flown at any height up to the maximum.

/DISADVANTAGES

(1) Breaking strength 1,300 lbs.

(2) Sub-Section page 302

DISADVANTAGES

Mark VI Tandem Barrage

1. Maximum effective impact speed 300 miles an hour. (This left little margin over the maximum speeds of the Dornier 217 and Foker Woolf 190 fighter/bomber).

2. Blow-away speed 40 miles an hour.

3. Future developments of cutter fairings might invalidate the Mark VI barrage.

4. Little variation of barrage height possible.

5. Speed of operation too slow for standard flying policy.

6. Less robust balloon.

Twin Cable Bomb Scheme

1. Low operational height.

2. Operational difficulties and lower effective speed limit unknown.

3. Any major change in height required two balloon operations.

These comparisons were made as the result of various experiments. It was apparent, however, that the time had now arrived when full-scale trials under operational conditions should be arranged. The Director of Fighter Operations accordingly instructed Fighter and Balloon Commands to make the necessary preparations so that the trials could be made as soon as the equipment became available. Because it was undesirable that the enemy should learn of the existence of the Twin Cable Bomb until all barrages were equipped with it the trials were to be carried out in an area which was unlikely to be attacked during the present phase of enemy tactics.

ibid. Encl.139A.

Equipment for the Twin Cable Bomb, stated the Director of Fighter Operations, should be available by the end of February, 1943, while that for the Tandem scheme would be ready some two weeks later.

The idea was that two barrages should be equipped with the Twin Cable Bomb and two with the Tandem scheme. By running the trials concurrently it would then be possible to ascertain which of the two schemes was likely to be the most practicable. Because the Air Officer Commanding, Balloon Command considered it essential that the trials should be undertaken in barrages manned by airmen, he proposed that they should be carried out in the following areas:-

ibid. Encl.146A.

Twin Cable Bomb Trials .....Crewe
Plymouth

Mark VI Trials .....Derby
Falmouth

This did not conform with the Air Staff requirement that the trials of the Twin Cable Bomb should take place in areas not liable to enemy attack, but under the circumstances there was no alternative.

/TWIN

AHB/IID/34/4/23(A).
~~KBC/S.52012/OPS.~~
Encl.128A.

TWIN CABLE BOMB - FIRST TRIALS

The Twin Cable Bomb trials commenced early in May at No. 964 Squadron, Plymouth, and No. 949 Squadron, Crewe, each squadron using four balloons that were made non-operational for the purpose. Training was carried out with full equipment except that dummy bombs and detonators were used.

During this phase a number of minor weaknesses in equipment came to light but these were easily rectified. Crews handled the new device without difficulty and in spite of the entirely new technique required, there was no reason to believe that they would not be able to operate the balloons in a satisfactory manner and within the accepted time limits.

Service trials using live bomb units commenced on the 1st July. By mid-day on that date, No. 949 Squadron had converted eight sites to Twin Cable Bombs, but being a second line barrage, remained grounded. At Plymouth No. 964 Squadron had five sites operating the Twin Cable Bomb which were flown at the ruling operational height. They had not been flying for long when the bottom bomb unit on one site detonated. Shortly afterwards, the bottom detonator at another site fired, but as this unit had not been paid out to a sufficient height to arm it, the bomb itself was not detonated. However, the bomb above it exploded two minutes later.

On the advice of the Balloon Development Establishment live bombs were immediately discarded and flying continued with dummy bombs and live detonators. Orders were also given that no more sites in either squadron were to be converted to Twin Cable Bomb pending further instruction.

On the 2nd July, between first and last light, ten more detonators fired at Plymouth and after taking advice from the technical experts, the Air Officer Commanding suspended the trials in both squadrons.

AHB/IID/34/4/~~22~~29(A)
~~KBC/S.5[illegible]11/OPS~~
Encl.88A.

THE TANDEM SERVICE TRIALS

The Tandem service trials commenced at No.918 Squadron, Derby, and No.959 Squadron, Falmouth on the 7th August, 1943. Both barrages flew under normal operational control; Falmouth as a first line barrage and Derby as a second line barrage.

The average time taken to complete a given operation did not differ materially from that taken with LZ balloons, but numerous delays occurred at individual sites. These were caused mainly by winch troubles and could not be accepted by Balloon Command from an operational point of view.

One of the main disadvantages of the tandem scheme proved to be the impossibility of arming the cable except at two fixed positions, 2,000 and 4,000 feet. Neither was there an indication, as had been hoped, that the size of each crew could be materially reduced below that required for LZ balloons. The casualty rate for balloons was also high, and when ground wind speeds were over 35 miles an hour, reached a level that was unacceptable. It was apparent, in fact, that for operation in countries, such as Great Britain, where wind and cloud conditions are unpredictable, the Tandem scheme in its present form could not be regarded as an adequate substitute for an LZ Barrage. Furthermore, its possible advantages as an anti-cutter device appeared to be more than offset by the difficulty of maintaining a barrage at all during the winter months.

It was clear, in fact, that the Tandem scheme was going to be of no value and it was abandoned in January, 1944.

/FURTHER

AHB/IID/34/4/23(A).
~~KBO/B.52012/OPS~~
Encl.113A.

FURTHER TWIN CABLE BOMB TRIALS

Meanwhile, the scientists were endeavouring to overcome the difficulties that had arisen with the Twin Cable Bomb, but with little success.

However, a second series of service trials was commenced at Plymouth on the 1st December, 1943. They were no more encouraging than the earlier experiments. In the first fortnight two accidents were reported. In one case a bomb exploded when the winch was started up, and in the second, all the bombs on the cable at one site exploded for no known reason.

Further improvements were clearly required and the Air Ministry were asked to consider whether 10 per cent of the Twin Cable Bomb equipment should not be further modified.

ibid.
Encl.148B.

"It appears", wrote Wing Commander V.R. Gibbs, of Organization 4, in a minute to the Controller of Research and Development, Ministry of Aircraft Production (Air Marshal F.J. Linnell)

> "that what we took out was really an insurance policy in July, 1942, to provide a counter in the event of the enemy using cutters... I understand that we have, to date, paid over 5 million pounds in premiums for this, but at the end of 1943 we have no answer."

This enormous expenditure was incurred because material to equip 1750 balloon sites were manufactured before waiting for the conclusion of the first trials and without waiting for any service trials. This was done because, as the Controller for Research and Development remarked in a minute to the Minister of Aircraft Production,

> "the enemy has a cutting device which renders our existing barrage well nigh useless... it is of the greatest importance that not a day be lost in introducing our new counter-device."

Had the equipment proved satisfactory, this policy would have been justified. As it was, constant modifications, new items of equipment, and various bottlenecks in production resulted in an ever increasing cost for no satisfactory result.

Wing Commander Gibbs went on to point out that it was for the Controller of Research and Development to balance the expenditure of labour, time, and material and to decide whether to modify further the existing equipment or to wait until more was known of the results of the present service trials.

In order to assist the Controller of Research and Development in making his decision Wing Commander Gibbs set out the following facts concerning the Twin Cable Bomb scheme:-

ibid.

"(a) The Chiefs of Staff Committee have before them at the moment a recommendation from the C-in-C., Fighter Command, to reduce the I.E. of the Home L.Z. barrage to 1138. Out of this number 31% of the sites will be operated by W.A.A.F. personnel who, according to A.M.O. A.673/43, are in no circumstances to be trained in the use of firearms or other lethal weapons. This ruling would appear to cut out W.A.A.F. sites from the T.C.B. scheme if it were ever introduced. Furthermore, it is very doubtful if W.A.A.F. personnel could operate T.C.B. as it is quite difficult to handle

/operationally.

operationally. This leaves us with a possible 793 sites for T.C.B. and no more unless W.A.A.F.s are replaced by R.A.F. which is against the policy of the Directorate of Manning.

(b) We built in 1942 bomb storage and control posts for the T.C.B. scheme at the following barrages:-

First Line Barrages

Plymouth.....23
Southampton.....32
Weybridge.....20
Langley.....20
Yeovil.....33 (To be manned by W.A.A.F.)

Second Line Barrages

Brookworth.....17 (To be manned by W.A.A.F.)
Filton.....20 (Now all manned by W.A.A.F.)
165

Less W.A.A.F. sites 70
95

It is not intended to use our very scarce labour and material to build anywhere else until we know the scheme is practicable and to be definitely proceeded with.

(c) Balloon Command has no intention of starting to train their very depleted personnel until they are given the final and proper equipment to train with, and this stage has obviously not yet been reached. Therefore equipment for training is not yet required.

(d) The number of personnel required to operate T.C.B. efficiently is not yet known, it will most certainly not be less than at present for D.P.L arming. Some specialist personnel other than balloon operators will most certainly be required. Any increase in the strength of crews for balloons at this stage of the war will most certainly meet with the strongest opposition.

(e) There is a great shortage of rubber and fabric to make balloons and we are continually being pressed to cut down our demands. The wastage over the past twelve months has been approximately 2½% a month of balloons flying. It is considered that if the T.C.B. arming was introduced the wastage would most probably increase."

Having considered these facts, it was for the Controller of Research and Development to decide what equipment, if any, should be modified on the basis of:-

(I) Labour, material, and time required for modification of each individual site.

(II) The likelihood of the scheme being brought to a stage where it would be of practical use and introduced in the service for either general use in balloon barrages, or to be used only if the enemy began to use the "Kutonase" on a large scale.

/The Controller

ibid. ... Min.116.

The Controller of Research and Development decided that:-

"it is clear that the misadventures met during the service trials are the type, the discovery of which is the object of service trials.... I therefore consider that in addidition to those being used for service trials, 10% of the equipment should be modified."

Before this ruling could be put into effect, however, the Air Marshal Commanding, Air Defence of Great Britain (Air Marshal Sir Roderic Hill) stepped into the picture.

ADGB/S.36749 /Ops. Encl.5A.

Pointing out that Plymouth was in range of fighter/bombers and was a target of increasing importance on account of the forthcoming offensive operations, he went on to state that he could no longer accept the limitation of operational efficiency which the Twin Cable Bomb imposed upon the barrage.

"Since this project was started eighteen months ago", stated Air Marshal Hill, "the tactical situation has entirely changed and most balloons are now deployed to counter attack by fighter/bombers, which aircraft do not carry a cutter and for which the normal armament of balloons provides adequate lethality. It is clear that before this device can be used, considerable further development work will be required and if and when it becomes technically satisfactory in the changed circumstances, its operational value is doubtful. After due consideration therefore, I consider that it would be better, even though a considerable quantity of material has been manufactured, to cut our losses rather than to expend further valuable time and effort on the development of this weapon. I therefore recommend that development work and trials of the T.C.B. device should not be pursued and that its introduction into operational service should be cancelled."

ibid. Min.129.

In April, the Assistant Chief of the Air Staff (Operations) intimated that the Air Staff no longer considered there was a requirement for the Twin Cable Bomb. An attempt was made to continue field trials at Cardington, but these were also cancelled when, on the 5th September, the Ministry of Aircraft Production finally informed the Superintendent, Balloon Development Establishment, that the Twin Cable Bomb scheme was cancelled.

Thus ended a most costly and unsuccessful venture.

/SECTION 16.

ENEMY ACTIVITY OVER BALLOON BARRAGE AREAS

ATTACKS ON BALLOONS

Balloon Command Bulletin No.7.

At 0850 hours on the last day of August, 1940, observers on the Kent coast saw two waves of fifty enemy aircraft approaching Dover at heights ranging between 15,000 and 20,000 feet. A few seconds later six Me.109s detached themselves from the main formation and attacked the balloons flying over the port. In six minutes they shot down the entire barrage of 23 balloons at a cost to themselves of 3 aircraft - 2 destroyed by anti-aircraft fire, and the third by rifle fire from balloon crews.

With no balloon protection it was to be expected that the main formation of bombers would now proceed to attack Dover from a low level. This, however, did not happen. The bombers proceeded on their course and attacked targets elsewhere.

Strenous efforts were made to replace the casualties and by 1130 hours one waterborne and ten land sites were again flying balloons; by the afternoon a further seven were airborne. But this happy state of affairs did not last for long, for at 1930 hours the barrage was again attacked by enemy fighters and fifteen balloons were shot down. By the next morning a further sixteen had been replaced and were flying.

Further attacks on the balloons were now expected and tactics to meet them were arranged between the local anti-aircraft commander and the commanding officer of the balloon squadron. Thus, when later in the morning enemy aircraft were sighted the balloons were hauled down to 500 feet and covered by a gun barrage, which at this height included light anti-aircraft gun defences. This manoeuvre proved highly successful, three enemy aircraft being shot down for the loss of two balloons.(1)

These three attacks on the Dover Balloon Barrage were the only attempts made by the enemy to eliminate a barrage in its entirety. The reason for their doing so remains obscure. Post war interrogation of senior German air force officers has, so far,(2) elucidated nothing. The targets protected by the balloons were not attacked. Nor could it conceivably be supposed that their policy was designed to force British fighter aircraft into combat, for the Germans must have been aware that the strength of the Dover anti-aircraft defences, particularly within the range of light anti-aircraft guns, was perhaps greater than at any other point in the British Isles. But whatever the reason a large-scale attack on balloons was never repeated. On several occasions single balloons were shot down by enemy aircraft, but these were generally ascribed to

"Roof Over Britain" p.64.

/individual

(1) It is interesting to note that a balloon crew again claimed one of these aircraft "destroyed by rifle fire." Two volleys of 50 and 20 rounds were fired in to the aircraft, which, exuding black smoke, apparently dived into the sea.

(2) June, 1945.

individual acts of daring by members of the Luftwaffe and were said to be frowned upon by the German authorities.

1939 - 1941

O & S Defence 241/8

The first so-called major air attack on a target protected by balloons occurred on 8th April, 1940, when about 24 enemy aircraft attacked Scapa Flow. Their objectives appeared to be the Hoxa and Switha booms. These were not hit and this, perhaps, is not surprising since bombing was carried out from heights ranging between 12,000 and 20,000 feet. One balloon was reported to have been machine-gunned, but survived.

This attack was typical of the early daylight raids. No attempts were made to shoot down the balloons as part of a strategical plan, nor indeed were any attempts made to fly below the height of the balloons. Occasionally, a single enemy aircraft would fly through a portion of a balloon barrage, but incidents of this nature were rare.

The same applied to night attacks on areas protected by balloon barrages. Invariably, these took place at a height well above the balloons. The bombing, therefore, was haphazard and, when the individual targets protected by balloons were hit, it was more a matter of luck than judgment on the part of the enemy. Again, there were exceptions to the rule. But generally speaking in the first two years of war the balloons admirably fulfilled their purpose by keeping the enemy flying high.

AHS/ID/34/2/3(C) KEW/E.50228 Encl. 118B.

Administrative Problems arising from major attacks.

On the night of the 14/15th November, 1940, the enemy attacked Coventry in force. This was the first occasion on which the German Air Force had been able to concentrate large numbers of aircraft on one comparatively small target.

Approximately 400 aircraft participated, bombing the city for some nine hours, and similar attacks, varying in intensity, were made during the ensuing weeks on Sheffield, Liverpool, Manchester, Southampton, Bristol and other cities and towns.

The tactics used by the enemy were almost identical on each occasion. The raids commenced shortly after dusk. The first aircraft, flying at approximately 10,000 feet, but rarely below this height, scattered incendiaries indiscriminately over the target area. Fires were started and the biggest were steadily bombed with high explosives by succeeding aircraft until shortly before dawn.

From the operational point of view, insofar as Balloon Command were concerned, these raids presented few problems. Administratively, however, a number of difficulties arose. Communications and public utilities suffered severely; roads became blocked and buildings damaged. But if the barrage was to function efficiently these services had to be resumed, or at least improvised, with the least possible delay.

Balloon Command Bulletin No. 22 Appx. "A"

In late December, 1940, Headquarters, Balloon Command circulated a summary of the lessons learnt during these major raids and issued instructions to overcome the difficulties that were not likely to arise after such attacks. These were as follows:-

/Water

Water

Lack of water, sometimes due to mains suffering direct hits and sometimes to hydrants being buried under wreckage, was a frequent occurrence. It was therefore ruled that water should never be relied upon to deal with incipient fires. In any case sand would perform this task equally satisfactorily.

Water bottles were to be changed daily for drinking purposes, and, for the same reason, fresh water in large containers was to be maintained at squadron and flight headquarters.

Gas and Electricity

Because gas and electricity supplies were also likely to be cut off, not only for a few hours, but possibly for days, Primus stoves were to be made available for emergency cooking; and while hurricane lamps were useful for obtaining the minimum light, they were not satisfactory for office work. In an emergency barrack lamps were to be moved from sites to offices.

Communications

Telephones were likley to fail for various reasons, and despatch riders hampered in delivering messages, not only because of the enemy activity that might be taking place, but also because roads frequently became blocked with wreckage. It was necessary, therefore, that alternative telephone systems from outside the bombed area to higher formations should be examined and arrangements made for use in an emergency. In the event of the failure of all land lines, despatch riders were to be acquainted with as many alternative routes as possible. As an immediate measure to restore communications between barrage control and sites, a mobile signals unit, known as the Balloon Command Signals Unit, was to be formed. This unit would be based on the Royal Air Force Station, Cardington, and advised immediately a heavy attack developed on a balloon protected area. A detachment would immediately set out, arriving there shortly after the conclusion of the raid. Squadron headquarters and sites, where communications had become unserviceable would be equipped with radio telephony sets which would remain installed until normal conditions had been restored by engineers of the General Post Office.

Ambulances

When casualties were removed from sites by ambulances crews were told to ascertain, where possible, the hospital to which they were being taken. While in most cases the hospitals reported Royal Air Force casualties, instances had occurred where this had not been done, and in consequence airmen were reported missing.

First Aid

The importance of practising first aid on balloon sites was emphasized in order that minor injuries might be dealt with on the spot, thus relieving medical orderlies of unnecessary work.

/Food

Food

It was a good plan to have food and hot drinks prepared for personnel on duty. Sometimes there were delays in the serving of early meals, and while this was no hardship, it was found that food and drinks helped to pass "bombing" time and thus assisted morale.

Shelters

Finally, while it was necessary for a number of airmen to be in the open during air raids, it was imperative that as many persons as possible should keep under cover. There was a tendency, particularly when experiencing a first raid, to stand outside and gape, but such unnecessary exposure was to be strongly discouraged. It was important, too, that personnel should not all congregate in one shelter when there was alternative accommodation.

1942

The "Baedeker" Raids

A.W.A. Report B2/14.

Towards the end of April, 1942, and just after the Royal Air Force raids on Lubeck and Rostock, the enemy, presumably by way of reprisal, made a series of vicious attacks on Exeter, Bath, Norwich and Bristol. These came to be known as the "Baedeker" raids and were the subject of an exhaustive analytical study by the Air Warfare Analytical Section of the Air Ministry, whose function was to decide upon reasons for the successor failure of enemy raids on this country.

In their report on the "Baedeker" raids the Air Warfare Analytical Section came to the conclusion that:-

> "the Hun can only achieve good concentrations (1) when he is allowed to deliver his attack from low level.
>
> It has been noted in past bomb census reports that the enemy has on no occasion produced accurate visual bombing where balloon barrage protection has forced him to fly even comparatively high, and this fact has been stressed both in fact and by inference in the raids under consideration. Alone of all the towns raided in April, Bristol was scattered, with most of the incidents in the outskirts of the barrage."

ibid.

The report then went on to describe how after Norwich had been heavily attacked on the 27/28th and the 29th/30th April, a balloon barrage was deployed over the city.(2) On the 8th/9th May, when Norwich was again the target, three parachute mines fell just outside the barrage area, while 51 tons of high explosive fell near the Royal Air Force Station at Stoke Holy Cross, and a further 11 tons were diverted by decoys.

> "These two facts", stated the Air Warfare Analytical section, "added to past experience of enemy attacks on protected towns, prove the value of a balloon barrage in frustrating enemy attempts at concentrated bombing. Furthermore, the fact that all the concentrated attacks were made at low level in the absence of balloon protection and that the concentrations achieved in these low level attacks were denser than any recorded in the blitzes on protected bomb census towns, justifies the inference that the presence of a balloon barrage would have reduced the "Baedeker" raids to the common level of past blitz experience."

/These

(1) of bombs.

(2) See Section 27 Operation "Crittall"

BC/15.

These views were reported in July, when the Air Warfare Analytical Section reported on raids that had taken place in June. The analysis suggested that the past year had resulted in a deterioration of the enemy's raiding efficiency where anti-aircraft fire and balloons had compelled him to fly high. (1) The raiding efficiencies in the "Baedeker" raids made at low level in the absence of balloon protection varied between 67 per cent and 90 per cent. The first raid on Canterbury was 86 per cent, but with the advent of a balloon barrage the raiding efficiency fell to 24 per cent and in a following raid to 25 per cent.

BC/18.
May, 1943.

In a report on night bombing covering the period December, 1942, to March, 1943, the raiding efficiency in 37 of the most important night attacks was analysed by the Air Warfare Analytical Section as 47 per cent. Included in these were 12 raids on towns in conditions favourable to accurate bombing, with no balloon defence and inadequate anti-aircraft defences, and their average efficiency was 77 per cent. In the remaining 25 raids, the towns attacked were protected by balloons and anti-aircraft barrages of varying intensity and the average efficiency achieved was only 25 per cent.

1943

During 1943, the enemy's air effort against the British Isles was , comparatively speaking, negligible, but there remained the potential threat of heavy attack, and balloons were retained as a precaution. There were a number of isolated incidents, such as the mid-day attack on London on the 20th January. At 12.29 hours on this day Headquarters, No.11 Group instructed the London Barrage commander to fly his balloons to 6.500 feet. Two minutes later six or more enemy aircraft flew over the still grounded balloons, firing at them as they did so. Bombs were dropped from a low height one hitting a school at Lewisham causing heavy casualties. Another fell on a balloon site wounding nine airwomen balloon operators. This incident provoked national comment. The public wished to know why the balloons were down. In the House of Commons, Lieutenant-Colonel Sir Assheton Pownall asked for an explanation and was informed by the Secretary of State for Air (Sir Archibald Sinclair) that:-

Hansard
26th Jan.1943.

> "The balloon barrage was close-hauled over a part of the London area on the morning of 20th January, because important maintenance work on the London defences was then in progress. This work can only be carried out in daylight. There was no question of negligence or default."

But this answer was misleading; for reasons of security, the truth had to be withheld.

FE/S.31822

What happened was that as the result of enemy interference the radar system at No.11 Group had been jammed and the enemy had been plotted on a most erratic course on the Operations Room tables at both Headquarters, Fighter Command, and Headquarters, No.11 Group owing to the main track splitting on the boundary between Maidstone and Horsham, Royal Observer Corps Group areas.

One track proceeded through the Horsham Group area towards London and the other through the Maidstone Group area towards Maidstone, but both tracks still carried the original designation (Raid 411) as both centres were under the impression that they were tracking the main raid. In consequence, the track plotted

/on the

(1) Raiding efficiency was the percentage of the total bombs dropped that fell within the boundaries of the city or town attacked.

on the Operations Room tables, from information received from both centres, showed a zig-zag course steering in the general direction of Maidstone. This impression was strengthened owing to the fact that two of the plots in the track steering for London, though transmitted by teleprinter by the Royal Observer Corps Centre, were not received at the teleplotters in the Operations Rooms, presumably owing to a mechanical failure. Thus, it was not until 1229 hours that plots indicated that the enemy was likely to attack London. The balloons were immediately ordered to fly. The order was too late, however.

AHB/IID/34/4/24
~~KBO/S.52073/~~
Ops.
Encl.13 OB.

There were other occasions when the balloons were apparently caught grounded. But each time they were grounded for a reason. A typical example of this occurred at Plymouth on the night of the 13th February, while a large scale bomber effort against Lorient was in progress. The balloons, normally flown at operational height, were grounded to ensure the safety of aircraft engaged on this operation.

At 21.48 hours, a number of enemy aircraft intermingling with the returning bombers commenced an attack on Plymouth from heights estimated at between 2,000 and 3,000 feet. The barrage control officer immediately contacted the balloon officer at No. 10 Group and reported the attack, but in the absence of any confirmatory evidence from the Royal Observer Corps as to the size of the raid, or indeed, that a raid was taking place, the control imposed upon the balloons was not released by the No. 10 Group controller until 22.05 hours, by which time the main weight of the attack had been delivered.

At 23.04 hours, the balloon officer at No. 10 Group spoke to the barrage controller at Plymouth and informed him that the raid was now considered over and the balloons were to be grounded. As gun fire was still continuing in the neighbourhood, the Plymouth barrage controller requested that the No. 10 Group controller should be informed of the fact. This was done, but the controller decided that the order to ground the balloons should stand. The attack ceased at 23.09 hours and orders were passed out to balloon sites to ground the balloons at 23.14 hours. Six minutes later a Lancaster collided with a balloon cable and as a result crashed into the sea.

SB.1832/
XI.

AHB/IID/34/4/24
~~KBO/S.52073/~~
Ops.
Encl.130B.

At the subsequent enquiry, it was stated:-

"The Controller at No. 10 Group appears to have rightly hesitated to order the Plymouth Balloons up in spite of the report that hostile acts were being committed in the area. There was a large number of friendly aircraft operating in the vicinity and his hesitation was based on the fact that there were no hostile plots on the table, and his wish to have the report from the balloon barrage verified.

From the balloon operational aspect, there is little upon which to comment, except possibly on the delay of about 7 minutes between the receipt at barrage control of the order for the balloons to be grounded and the passing of this order to sites."

ibid.
Encl.130A

Commenting upon this the Air Officer Commanding-in-Chief, Fighter Command, stated:-

"it is considered that the Barrage Control officer was justified in delaying the issue of the grounding order while he confirmed with the Balloon Officer at No. 10

/Group

> Group that the Controller was aware of the current situation over Plymouth."

Thus, it will be seen that the fact that the balloons were grounded during the major part of the attack, and a British aircraft was destroyed as a result of the balloons being raised was, in fact, due to unfortunate circumstances.

1191/Ply. 1127 19.6.43.

Five months later on the 13th/14th June, the enemy again caught Plymouth with its balloons down. On this occasion the balloons were grounded for a terminable general purpose control. At 00.10 hours the first hostile raids were plotted some 45 miles from the port, at a height of 1,000 feet. Headquarters No.10 Group released the control at 00,12 hours and the balloons were ordered to fly to 4,500 feet. They reached this height by 00.36 hours. In the meantime the enemy had arrived over Plymouth at 00.19 hours and in the early stages of the attack flew at a low height.

Incidents of this nature normally resulted in some form of repercussion, and these two cases were no exception. On the 19th June, the Commander-in-Chief, Plymouth (Admiral of the Fleet, Sir Charles Forbes) informed the Admiralty of the attack pointing out that while he appreciated

191/Ply.127

> "that our own aircraft must be protected during operations and exercises, it is felt that the absence of the balloon barrage during air raids removes a definite danger from the path of low flying hostile aircraft, and allows the enemy accurately to pin point his target with flares. Moreover, (and this point I want particularly to stress) I find it extremely difficult to explain to the 20,000 or so dockyard workers, their families and the families of our men, why Plymouth is always being caught with our balloons down. When the warning goes, these people see the balloons are down, and see them go leisurely up and I feel certain their Lordships will agree with me that everything possible should be done to maintain their morale, particularly as the dock-yard have been working so well."

Whatever individual opinion might have been held on the value of balloon defences, it is clear from this and many similar statements that the population generally held them in high regard.

1944

W.A.Report No.BC/29. H.Q. Balloon Command. "Enemy Activity over Barrage Areas". No.1/44 et seq.

Early in January, the enemy resumed the attack on London. Reprisal raids, designed to terrorise the citizens of the capital and to put heart into the already despairing peoples of Germany, were carried out until the end of March. From the balloon operational aspect they presented no problems. Throughout the great majority of the attacks the balloons flew at 1,000 feet under a standing over-riding control imposed to facilitate the working of gun-laying instruments. The enemy made no effort to fly low. Their tactics were to bomb marker flares from heights varying from 10,000 to 20,000 feet. Minor damage was caused to balloon huts and billets; a few squadron and flight headquarters lost their windows; and No.1 Balloon Centre, Kidbrooke, had a lucky escape when a 1,000 pound high explosive bomb dropped on a road between the camp and the officers mess. The raids were a nuisance, but the presence of the balloons, whether flying at their full operational height or bedded down on the ground, had no effect whatever on their outcome.

/Later in

Later in the year came the flying bomb, when balloons, for the first time, played a part that could be accurately assessed instead of indefinitely inferred. The subject is dealt with fully elsewhere.

SECTION 17

W.A.A.F. SUBSTITUTION IN BALLOON COMMAND (1)

The rapid expansion of the three fighting services, the civil defence services and the ever increasing requirements of war industries during the year 1940 made it necessary for the most stringent economies to be made in man-power.

In so far as the Royal Air Force was concerned the allocation of manpower was the responsibility of the Director of Manning, (Air Commodore J.W. Cordingley). Having reviewed and, where possible, made arrangements to reduce the strengths of all Air Force commands, Air Commodore Cordingley turned his attention to the question of substituting women of the Women's Auxiliary Air Force for men of the Royal Air Force, thereby releasing the men for more active duties. On the 18th January, 1941, he wrote to the Air Officer Commanding, Balloon Command, requesting him to investigate the possibility of employing airwomen for airmen in the trade of balloon operator. Air Marshal Gossage replied that he did not feel inclined to recommend the proposed substitution. His reasons were that the living conditions of balloon operators were not good; their work required great physical strength; while almost all his staff, who had had experience of balloon operating, were convinced that women would not be able to perform the task satisfactorily.

The Director of Manning, however, was not convinced and requested that an experiment be carried out, as soon as possible, to ascertain the possibilities of the employment of women in the trade.

Air Marshal Gossage, until very recently the Air Member for Personnel, knew only too well the seriousness of the man-power situation and was aware from Air Commodore Cordingley's insistence that the substitution of airwomen for airmen was inevitable. He therefore threw himself with the greatest enthusiasm and endeavour into the task of ensuring that the experiment should be successful. That it was ultimately possible to substitute airwomen for airmen was due as much to his efforts as to those of the airwomen themselves.

Conditions of Experiment.

The first decision which Air Marshal Gossage had to make was whether balloon crews should consist of airmen and airwomen, or airwomen only. Because

> "he was impressed with their ability and felt that their prestige would be greatly enhanced if they were to work in crews by themselves and under their own N.C.Os."

and because he

> "foresaw administrative difficulties if mixed crews were to be employed"

he decided against mixed crews.

It was also necessary to decide the strength of each

/crew.

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(1) This section is based on a report made to the Air Ministry by Air Marshal Sir Leslie Gossage, Air Officer Commanding, Balloon Command, in September, 1942; and on the observations of the writer during the period 1941/1944. Where facts or quotations are made other than those recorded in the report by Air Marshal Gossage, the source is quoted marginally.

crew. A crew of airmen consisted of 12 men (2 N.C.Os. and 10 airmen (1)). Tests were carried out to see what the airwomen could do, such as carrying gas cylinders, handling the heavy ladder provided on balloon sites, etc., and it was considered first that not less than 20 airwomen should be allowed for each balloon site. Subsequent discussion, however, reduced this figure, first of all to 18, and later to 16 women (2 N.C.Os. and 14 airwomen).

Having reached a decision on the two major problems, Air Marshal Gossage called for 300 volunteers from members of the Women's Auxiliary Air Force serving in his command. 265 airwomen were forthcoming and 247 were accepted, mostly from the trade of fabric worker. There was a great advantage in this in that the airwomen were already familiar with the characteristics of the balloon itself and were not nervous about handling it; a trait later found to be not uncommon among the airwomen.

The Royal Air Force Station at Cardington was selected for the training of the first group of airwomen, because

> "the necessary accommodation was available and there were good facilities to enable balloons to be flown in numbers without serious restriction."

Effect of Substitution on Airmen.

The news of the impending experiment was not well received by Royal Air Force balloon operators. This was due to the fact that they did not appreciate the urgency of the manpower situation. They felt, too, that the decision to substitute women in their place reflected on their past efforts and would lead those sections of public opinion, which did not understand the nature of their work, to the conclusion that they had not be contributing their full share to the war effort. (2)

This impression was firstly counteracted by a number of properly informed announcements and, later, by the airwomen who were quick to appreciate the part the airmen had played in the advancement of balloon technique. Thus, the airmen, convinced that they were needed more urgently elsewhere, began to treat the advent of the airwomen, if not with enthusiasm, at least with toleration.

The Experiment.

The idea underlying the training policy in Balloon Command was the standardization of airmen balloon operators in various states of proficiency. Now a position had arisen whereby a course of training needed to be evolved for the airwomen balloon operator trainees who had had no previous experience whatever. A programme was worked out therefore while the preliminary discussions concerning the experiment were in progress.

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Encl.24A.

Entries of 68, 58 and 54 airwomen joined at Cardington at weekly intervals commencing on the 5th May, 1941. This gave a peak of 247 in training simultaneously. The course of training decided upon was one of ten weeks duration. The first eight

/weeks were

(1) This was finally reduced to 2 N.C.Os. and 7 airmen.

(2) Students of contemporary history will remark that the same prejudice against the employment of women in jobs hitherto regarded as the sole and right preserve of men, appeared in many other departments of national life during the war years.

weeks were devoted to theoretical instruction in rope, wire, fabric, balloons and balloon flying, winches and armament, coupled with practical instruction in every phase. This was followed by two weeks on a training site in the camp which simulated, as closely as possible, conditions on an operational site. It was subsequently decided to include one week's leave, between ab initio training and training on operational training sites, making a total of eleven weeks. At the end of this course a Central Trade Test Board examination was held and the airwomen graded accordingly to their ability. Some of the original N.C.Os. necessarily retained their rank, irrespective of the merit displayed on passing out.

The scheme was officially launched on the 10th July, 1941, by a formal passing out inspection carried out by Air Marshal Gossage at Cardington. The inspection was attended by the Director of Manning, the Director-General of Medical Services (Air Marshal Sir Harold Whitingham), and the Director of the Women's Auxiliary Air Force (Air Commandant K. Trefusis-Forbes). The visitors were impressed with what they saw, and it was generally considered that the substitution of airwomen for airmen was likely to be a practical proposition.

War Sites.

On their passing out, the first trainees from Cardington were distributed to operational sites as follows:-

One flight of eight balloons was taken over by the airwomen from airmen at Sheffield and one site was manned by women in each of the balloon barrages at London, Portsmouth, Glasgow and Cardiff. The object of this distribution was to obtain a general opinion of the progress of the experiment through the location of one or more balloon sites in each of the five groups.

Whilst training had been in progress improvements had been made in the accommodation at war sites to be taken over by the airwomen. Apart from the extra numbers involved, it was considered advisable to provide a more comfortable scale of accommodation. With difficulties in the provision of material and shortage of labour it was not easy to ensure that the quarters were ready by the time that trainees passed out from Cardington, and the necessity of keeping the provision of accommodation in phase with requirements was, and for some considerable time remained, a constant problem.

Occupation of the sites commenced on the 16th July, 1941, and just over a month later, Air Marshal Gossage reported to the Air Ministry that the experiment had been sufficiently successful to warrant its extension to the limit considered advisable on operational grounds.

Substitution Plan.

The Air Ministry thereupon decided that substitution was to be carried out on sixty-six per cent of all balloon sites in Balloon Command, giving a target figure of 31,800 airwomen to be trained as balloon operators (1) and to be located on balloon sites by the 1st April, 1943.

/A subsequent

(1) This figure was arrived at on the assumption that balloon crews would consist of 16 airwomen. They were reduced finally to 12 airwomen.

A subsequent reduction in the personnel establishment of Balloon Command lowered the number of sites to be occupied by W.A.A.F. to 1400; certain sites in unhealthy localities, such as dock areas, being excluded from occupation. A later decision, made at the request of the Commander-in-Chief, Home Forces, that the barrages at Harwich, Dover, Portsmouth, Southampton, Plymouth and Falmouth (where balloon sites and their crews formed definite elements in the active defence of these areas) should not be manned by women, further reduced the number of sites to be occupied by them to 1,260, producing a requirement of 21,000 W.A.A.F. balloon operators to be trained and deployed on sites as soon as possible.

Training Arrangements.

To reach this target a large scale plan of training had to be worked out. A suggestion was put forward that this should be carried out under the auspices of Technical Training Command. This was very soon abandoned, however, when Air Marshal Gossage pointed out that it could be undertaken by Balloon Command with the great advantage, that intimate touch could be maintained with the airwomen after they had reached operational sites.

The first intention was to concentrate all training at Cardington, taking over accommodation from other commands stationed there as lodger units. This was discarded, however, owing to the large W.A.A.F.trainee population which would collect on one station; in addition, it was found that there would be insufficient room for all the balloon flying that would be required with so much training in progress.

The plan finally adopted was to spread the training between Cardington and thirteen of the ballon centres. At Cardington it was decided that there should be weekly intakes of 70 airwomen which, with an eleven weeks course, worked out at a total of 770 trainees. At each balloon centre the average weekly intake of trainees for a course of the same period was 29 with a peak of 319 airwomen. Intake at centres was increased to 32 on the 7th May, 1942, making a peak of 352.

Officers.

Although it was originally contemplated that officers of the Women's Auxiliary Air Force involved in the substitution plan should be used only for duties in connection with the welfare of the airwomen, it was considered advisable that they should have some form of balloon training in order that they might more readily sympathise with the airwomen in the exacting work which they were carrying out. A six weeks course was accordingly planned and completed by the first six officers, but as a result of the experience thus gained and in view of the increasing numbers to be trained, it was decided to simplify the syllabus and reduce the course to one of three weeks duration.

The Need for Non-commissioned Officers.

One of the main problems that arose as a result of the speed with which substitution took place was that of finding airwomen who possessed the qualities of leadership necessary for non-commissioned rank.

The first non-commissioned officers were obtained from the original volunteers, but the supply soon became exhausted and promotions had to be made within the various units. It soon became apparent, however, that the most suitable candidates for non-commissioned rank were not of a sufficiently high all-round standard to warrant their promotion. Air Marshal Gossage decided, therefore, to initiate a course for airwomen holding the classification of leading aircraftwoman who were recommended by their commanding officers as being suitable for promotion.

/This

This course was of three weeks duration. The first week was devoted to balloon handling in order to ascertain the airwoman's capabilities when placed in charge of a crew. During the remaining period she was given the necessary training in those duties with which she would have to contend as a non-commissioned officer. Airwomen who successfully completed the course were granted the rank of corporal.

The improvement in the standard of non-commissioned officers since the inception of the course was encouraging and ultimately all non-commissioned officers promoted prior to its inception attended it.

Accommodation.

The accommodation of the airwomen at squadron and flight headquarters as well as at sites proved to be a difficult problem. A Royal Air Force balloon crew was provided with a hut 36 feet x 15 feet in size, with internal cubicles for ablutions and store or with the equivalent in other types of hutting or requisitioned buildings.

The original approved scale of accommodation for a site to be occupied by airwomen consisted of three 36 feet huts, divided to provide a sitting room, kitchen, mess room, drying room, food store, site store and sleeping accommodation with separately built latrines.

With the reduction of the crew to sixteen, combined with an Air Ministry instruction that sleeping accommodation was to be reduced from 45 to 38 square feet, a revised scale of site accommodation based on 2½ huts, plus ablutions and latrines was issued.

Wherever possible, buildings were requisitioned, but if not available adjacent to the site, a hut was built for the use of the site guard and to provide shelter for the crew.

The accommodation difficulties at squadron and flight headquarters were due not only to the increased numbers of personnel for whom accommodation was required but also to the fact that the segregation of sexes involved duplication of latrines and ablutions, and other problems of this nature.

The scale of sick quarters accommodation also required revision, partly by reason of the fact that whereas sick beds were provided for airmen on the basis of one per cent, the provision for airwomen was two per cent and at the same time it was necessary to contend with increased numbers.

Clothing.

It was clear from an early stage that an alteration in dress would be necessary for airwomen balloon operators, and several additions were made to the scale of clothing. The original volunteers attached to Cardington for the first balloon course were issued with aircrew suits, but as soon as the experiment had proved successful a garment more suitable for women was designed and issued. This was known by the somewhat cumbersome title of "working dress serge" and was in fact almost identical in design with army battle dress. It was worn on all occasions on the site and was protected during working hours by a "suit, combination blue." (1) A high neck, long sleeved pullover completed the ensemble.

/Having

(1) A boiler suit.

Having provided for suitable clothing which in addition to leaving the airwomen unhampered by skirts, ensured warmth during the coldest winter months, it was necessary to consider other items of apparel. Boots were added to the scale; at first, small sized airmen's ankle boots were issued, but these were soon replaced by a lighter and slimmer fitting style more suited to the female foot; airmen's socks were issued for wear inside these boots, while oilskins, sou'westers and rubber knee boots were also added - these being issued on loan from flight headquarters in order to lessen the airwomen's load on posting. Sea-boot stockings were obtained from Royal Air Force Comforts but the demand was so great that it proved impossible to provide every airwomen with a pair for some considerable time. In the early days of the experiment navy blue berets were issued as head gear for the airwomen but were withdrawn and cap comforters or the ordinary peak cap supplied instead.

Medical Aspect.

When the question of substituting airwomen for airmen first arose, doubts were raised in the minds of the medical officers at Balloon Command whether or not women could undertake the strenuous work entailed without their health being adversely affected. They considered it not improbable that muscular strain, rupture or displacement or interference with the function of the generative organs might occur. In consequence, an initial medical standard was laid down for airwomen balloon operators. This was as follows:-

Height.	62 inches
Physical condition.	Candidates to fit Grade I, robust in all respects, capable of lifting weights, minimum 40 lbs.
Vision and hearing.	Not less than standard II.
Menstruation.	No abnormality.

The height standard was subsequently lowered to 60 inches, and it was further ruled that no women who had been pregnant should be selected, with a view to avoiding gynaecological examinations to ascertain if the pelvic organs were sound.

Observations were made on batches of trainees at centres and on a number of airwomen at sites, while monthly records of pulse responses to exercise, and blood pressure readings were made. The incidence of menstrual irregularities was found to be no more common with airwomen employed on balloon sites than with women in civil life. Records were also kept to compare the incidence of disease to which balloon operators might be thought particularly liable owing to the nature of their employment, such as respiratory, rheumic, digestive, pelvic troubles and accidents. The result of these tests and records revealed that, in spite of the loading against balloon operators, the incidence of sickness among them over a long period was no greater than among airwomen of other trades. In fact, if anything, the general physical condition of the airwomen balloon operators showed an improvement. Accidents among airwomen balloon operators were more frequent. But this was to be expected owing to the nature of their work. It is interesting to note, however, that during the course of training 16,000 airwomen, only three serious accidents occurred. The

/majority

majority of minor accidents were due to carelessness such as tripping over wires, loose bricks or debris, resulting in bruises, sprains and occasional fractures. Minor burns were comparatively frequent, and almost all were attributable to lack of experience in handling cooking and other stoves on the balloon sites.

Redundant Airmen.

Meanwhile, a large-scale scheme for the placing of airmen declared redundant had been in progress.(1) Some airmen were ultimately transferred from Balloon Command either for direct remustering to a new trade, to training in an alternative trade, remustering to general duties, or recommended for discharge. It was, of course, the intention to transfer a very much larger number of airmen, but the effect of the redundancy scheme was somewhat neutralised by the creation of three mobile squadrons (2) and two special duty squadrons, (3) together with the establishment of 50 balloons for reinforcing existing barrages. Airmen were also required for the balloon squadrons which were needed for service overseas.

Final Situation.

Air Ministry Bulletin No.17385.

Information from Gp.Capt. Org. H.Q., Balloon Command.

By the end of 1942 there were nineteen times as many balloon sites manned by members of the Women's Auxiliary Air Force as there were at the beginning of the year. At the peak period - 13th January, 1943, when the scheme was finally concluded - 1,029 sites had been occupied involving nearly 18,000 airwomen. But this number soon began to dwindle as economies were made in the man/woman power of Balloon Command and by the summer of 1944 when the Germans launched their flying bombs against London and Southern England only 379 sites were manned by airwomen.

Redundant Airwomen.

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Encl.4A.

On the 8th January, 1943, the Air Ministry informed Balloon Command that no further balloon operator trainees of the Women's Auxiliary Air Force were to be remustered to the Group II trade of balloon operator. Those already under training were to be examined by the Central Trade Test Board for remustering to another trade and would then be placed at the disposal of the Air Officer in charge of Records.

ibid.
Encl.8A.

Meanwhile, a reduction was being planned in the personnel establishment of Balloon Command (4) and on completion of this it was anticipated that the final numbers of balloon sites would comprise 960 manned by the Royal Air Force and 560 manned by the Women's Auxiliary Air Force, and that the crews would consist of 9 airmen and 12 airwomen respectively.

The number of airwomen employed on sites at this time was 15,601. A further 2,307 were still undergoing a course of training. The requirement for 560 Women's Auxiliary Air Force sites was 6,720 making a total of 11,188 airwomen who would become redundant. To dispose of this number without affecting the operational efficiency of the command meant that it was necessary to retain those airwomen who were the best balloon operators. This was achieved by ensuring that, as far as possible, airwomen in the classification of aircraftwomen second class (of which there were 7,726 in the command), /were those

(1) The procedure of the scheme is governed by A.M.O.A.675/41.
(2) See Section 27. Operation "Crittall".
(3) See Section 22. Operation "Petard".
(4) See Section 28.

were those who were put forward for remustering to the trades that were at present open to them. (1)

On the 22nd February, 1943, Headquarters, Balloon Command outlined to groups the policy to be followed in effecting the reduction of airwomen balloon operators. This was as follows:-

(a) Airwomen desirous of transferring to other trades (2) should be allowed to do so.

(b) The best and keenest airwomen should be retained in the command.

(c) No airwoman should be lost to the service by electing discharge.

Observing these principles, centres were instructed to select airwomen in the following numbers:-

No.30 Group	No.1 Centre	400	
	No.3 Centre	460	
	No.4 Centre	610	1,470
No.32 Group	No.11 Centre	880	
	No.14 Centre	680	1,560
No.33 Group	No.6 Centre	1270	
	No.8 Centre	1040	
	No.10 Centre	780	
	No.16 Centre	660	
	Sutton-on-Hull	250	4,000
No.34 Group	No.15 Centre	800	
		1080	1,880
		TOTAL	8,910

ibid. Encl.146. et seq.

Further remusterings were made in the summer of 1944, when a reorganisation was made entailing the employment of almost all the resources of Balloon Command in one operation. (3) This was virtually the end of the employment of airwomen balloon operators, but to remuster them to different trades was not as straightforward a problem as it had been in the past. An Air Ministry Order, (4) issued in 1944, limited the period, during which redundant airmen or airwomen could retain the pay of their former rank or classification and trade group, to six months.

/In the

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(1) These trades were:

Flight Mechanic A. and E.
R.T. Operator
Electrician II
Drivers M.T.
Instrument Repairer
Wireless Operator
Cooks.

(2) These trades were:

Flight Mechanic A. and E.
Instrument Repairer
R.T. Operator
Wireless Operator
Electrician II
Cooks
Drivers M.T.

(3) The Anti-Diver Balloon Barrage. See Section 31.

(4) A.M.O. A.533/44.

ibid.
Encl.156A

In the past it had always been possible to obtain certificates of willingness from the airwomen to remuster to other trades in sufficient numbers to liquidate any surplus that arose. On the 8th July, 1944 however, the Air Officer Commanding, Balloon Command, informing the Air Ministry that he had a large surplus of airwomen who would have to be remustered, stated that he anticipated difficulties in obtaining certificates of willingness from the airwomen owing to the amended conditions under which remustering now took place. At the time there were practically no Group II trades to which the airwomen could remuster, or in fact, very few trades in any other group, so that the Air Officer Commanding was faced with the task of persuading airwomen to sign a certificate of willingness to remuster when they were aware they would not retain their present rate of pay for longer than six months. Nor could they do anything through their own efforts to maintain that rate of pay, since they were precluded, by force of circumstances, from entering a trade in the same group as that in which they were now mustered.

In these circumstances, the Air Officer Commanding strongly recommended that the airwomen should be permitted to remuster under the terms of an earlier Air Ministry Order (1) under which they retained their former rank or classification and trade group indefinitely.

ibid.
Encl.66A.

As a result the Air Ministry decided that the airwomen balloon operators should be employed in trades not requiring training and where manning needs were paramount. For the time being, the question of redundancy would be left in abeyance. Nevertheless, as a safeguard for the Air Ministry, the airwomem were examined with a view to ascertaining their suitability for training for, or direct remustering to, other trades in which there might be vacancies. Meanwhile, 465 airwomen had remustered under the terms of the latest Air Ministry Order and were now in a position whereby they would lose their Group II pay after a period of six months if the remustering already effected was allowed to stand. Their predicament was brought to the attention of the Air Ministry who ruled that the airwomen should retain their Group II rates of pay for a period of twelve months from the date of commencement of training in the new trade, or, in the case of airwomen remustered without undergoing training, from the date of remustering.

The Effectiveness of the Substitution Scheme

In order to arrive at a just appreciation of the effectiveness of the substitution scheme, it is necessary to examine the capabilities of airwomen as balloon operators; whether in fact an ecomomy in man-power was achieved by substituting them for airmen; and, whether the effort involved was worth while.

AHB/IID/34/5/13
~~KBO/3.51571/41~~
~~Org.~~ 25/3/42.

Capabilities of the Airwomen

In March, 1942, Wing Commander J.N. Browne, of Headquarters, Balloon Command, and Mr. E.A. Smith of the Establishment directorate, Air Ministry visited flight headquarters and sites manned by airwomen in Nos.939 and 940 Squadron, Sheffield. The purpose of this visit was to carry out an investigation into the greatest number of sites that could be manned by airwomen in any one flight, and it was necessary, therefore, for them to consider in detail the strength and weakness of existing flight organisations which provided for up to 13 sites manned by airwomen in each flight. In their subsequent report it was stated that:-

/"W.A.A.F. crews

"W.A.A.F. crews in comparison with R.A.F. crews show lack of initiative and forgetfulness which is, and will for some considerable time be aggravated, if not caused by, unavoidable withdrawal of W.A.A.F. personnel for promotion. This can only be overcome by supervision far in excess of that required by R.A.F. crews."

In flights with only 8 sites manned by airwomen, a Royal Air Force flight sergeant and two sergeant balloon operators supervised training; in large flights there was an additional corporal balloon operator for this purpose. It was also found necessary to make a change in the Hydrogen Heavy Lift Party established in these flights. This consisted of one corporal and three aircrafthands (general duties) whose functions were:-

"Hydrogen movements, assistance in starting winches (as airwomen are not permitted to use starting handles), delivery of coal, preparation of hard standings and other heavy work, and assistance where necessary with construction and re-construction of soak pits."

It was now proposed that balloon operators should carry out these duties, as in addition to doing the heavy work, they would be able to assist in training the airwomen. At large flights where there were 9 or more sites manned by airwomen a further airman balloon operator was established on the Heavy Lift Party. Thus, at each of these large flights 2 corporals and 4 aircraftmen balloon operators were established for training in addition to the flight sergeant and two sergeants.

ibid.
Encl.19A.
"Org. Visits".

This establishment came up for review a year later when in March, 1943, Wing Commander Browne visited units in London, Birmingham, Manchester and Glasgow. By this time considerably more experience had been gained of the capabilities of the airwomen balloon operators. But Wing Commander Browne was not convinced that they were as efficient as the airmen.

"While nothing untoward happens", he wrote in his report,

"the administrative and operational efficiency with a trained male crew as compared with a trained female crew is no greater than would normally be expected from any crew of men competing with women. When an emergency happens the male crew rise to the occasion but the female crew go to pieces entirely, because however well-trained they may be, women do not possess the essential qualities of captaincy, initiative and resourcefulness. Even if we substituted 20 (instead of 12) women for 9 men, these women could not always satisfactorily operate a balloon site because ballooning requires a quality of mind which women, working alone, do not possess. It is certain that W.A.A.F. balloon crews will always require a "backing" of R.A.F. personnel."

To substantiate this statement, Wing Commander Browne quoted verbatim comments made to him during his tour by squadron and flight personnel. (1)

/His views

(1) The following are some of the statements quoted:-
"With one man on the site to help I get 100% more work done".
"In real rough weather I have had one corporal on every site all day long."
"I must send a man - any man will do."
"They are all right so long as there is a man on the site - I've even sent a telephone operator."
"If the balloon is slightly damaged the W.A.A.F. won't go near it."

AHB/IID/34/4/9(A)
~~KBC/S.51046/~~
Ops.
12/5/43.

His views were supported by a note written two months later by Wing Commander N.B. Thompson of Headquarters, Balloon Command:-

> "....apart from training there are and always will be many occasions when W.A.A.F. crews require assistance in connection with ballooning and at such times it is the definite experience that only R.A.F. personnel, particularly officers can satisfactorily cope with the situation. A W.A.A.F. crew, in an emergency, responds to the encouragement of an R.A.F. officer much better than to a W.A.A.F. officer."

"Org. Visits" Para.6(b) Encl.19A.

This reference to W.A.A.F. officers was an over-statement, for as Wing Commander Browne pointed out in his report:-

> "Administratively W.A.A.F. officers... are pulling their weight well. From a balloon handling point of view the position can be summarised in the words of one Flight Commander who said they were 'either very good or no good at all.'"

These views were, in fact, identical with those held by most of the officers at Headquarters, Balloon Command, and were confirmed by experience. But in fairness to the airwomen it must be borne in mind that they were all extremely young, their average age being 19 years. Originally it had been intended that some squadrons at least should be operated entirely by airwomen serving under Royal Air Force officers. This plan was abandoned as impracticable, and each squadron in which the majority of balloon operators were airwomen was reinforced by having at least one flight manned by the Royal Air Force. Later it became necessary to strengthen the flights manned by the Women's Auxiliary Air Force by introducing at least one Royal Air Force site; these airmen being additional to those who supervised the continual training that the airwomen (1) required.

Interview with Gp.Capt. Org., H.Q. Balloon Command.

There were two further disadvantages in the employment of airwomen balloon operators. They could not be used in mobile squadrons; nor could they be used where there were poor living conditions. In 1944, when Balloon Command deployed over 2,000 balloons in the south-east counties as part of the defences of London against flying bombs, it was not possible to use a single airwomen as a balloon operator because the conditions of living were so completely unsuitable. The men lived in tents; fetched their water from the nearest tap, which in some cases meant carrying a bucket for half a mile; and, of course, the sanitary arrangements were primitive. There was not time to build the hutted accommodation, or the latrines and ablutions required for airwomen. And even if there had been, the problem would not have been solved, for in a deployment of this magnitude many of the balloons were sited hundreds of yards from roads, and hydrogen cylinders had to be manhandled by balloon crews to the sites. These were but a few of the problems that would have had to be solved. The question of using airwomen was discussed, however, but the Director of the Women's Auxiliary Air Force (Air Commandant Lady R.E. Welsh) visited the barrage and immediately ruled that airwomen were not to be employed in it as balloon operators except as a last resource.

Interview with Group Officer G.E. Woodhead, D.D. W.A.A.F.

/The Economy

(1) Royal Air Force flights required only 2 N.C.O. instructors, as against the 5 N.C.O.'s and 4 airmen balloon operators required for W.A.A.F. flights.

The Economy Achieved by the Substitution Scheme

D/155/1942. 29. Although it had been planned that the substitution of airwomen for airmen balloon operators should release some 14,952 airmen for remustering to other trades in point of fact only a small percentage of airmen were so remustered. Nevertheless, the substitution made available a large number of airmen for duty in balloon squadrons overseas. On the other hand additional manpower was diverted to build and erect the extra accommodation required on each site to be manned by airwomen, and the fact remains that it proved necessary to have at least 18 airmen balloon operators in each Women's Auxiliary Air Force flight. Thus, by the beginning of January, 1944, an average flight of 10 balloons manned by airwomen comprised:-

Officers		Other ranks	
R.A.F.	W.A.A.F.	R.A.F.	W.A.A.F.
2	1	18	131

A similar flight manned by airmen, however, only required 3 officers and 110 other ranks - a saving of 39 pairs of hands.

It would appear very much open to question, therefore, whether the employment of women balloon operators is normally an economical preposition, bearing in mind that in many other forms of national service women can be substituted for men on the basis of one woman for one man.

Conclusions

Under the circumstances the effort involved in the substitution was probably worth while. Balloon Command were able to form squadrons for service overseas at a time when the manpower situtation was critical and without affecting the strengths of barrages required for Home Defence. It is unlikely that they would have been able to do so if the airwomen had not been forthcoming. As to the airwomen themselves, they performed their task, if not with the efficiency and skill of airmen, at least adequately.

Airwomen in Action

It is necessary in concluding this review of the activities of the balloon operators of the Women's Auxiliary Air Force to remark that the airwomen, when called upon to face the dangers of war, did so with the same unflinching and unquestioning spirit as their brothers in the Royal Air Force. For their heroism, or for outstanding work, while serving in Balloon Command, three officers of the Women's Auxiliary Air Force were admitted to the Order of the British Empire; five airwomen were awarded the British Empire Medal, and two were commended for bravery - not, it would seem a very generous distribution of honours and awards to a body of women who probably underwent as much danger and hardship as any other branch of the women's services.

/ SECTION 18

SECTION 18

RE-ORGANISATION IN BALLOON COMMAND 1940 - 1942

Reduction in the Number of Squadron Headquarters

H.Q. Balloon Command F.540 17/3/40 Appendices 9 and 10 26/2/40

In March 1940, the Air Officer Commanding, Balloon Command submitted to the Air Ministry a scheme for reducing the number of squadron headquarters in the Command and thus securing a reduction in personnel. His proposal, which had been discussed at a meeting of Group Commanders held in February, involved the elimination of 8 squadron headquarters with an estimated saving of approximately 48 officers and 350 airmen. Flights administered by the squadrons to be eliminated would be absorbed in other squadrons operating in the same area. On consideration by the Air Ministry the elimination of 6 squadron headquarters was approved and resulted in the following re-organisation:-

In No. 31 Group, No. 954 Squadron (Birmingham) was eliminated, No. 911 Squadron increased from 4 flights to 6 flights (48 balloons), and No. 913 Squadron increased from 3 flights to 5 flights (40 balloons). No. 920 Squadron (Liverpool) was disbanded and its flights absorbed by No. 919 Squadron, increased from 4 flights to 5 flights (40 balloons) and No. 921 Squadron increased from 4 flights to 6 flights (48 balloons). In Manchester, Nos. 925 and 926 Squadrons were each increased from 3 to 5 flights (40 balloons), and No. 955 Squadron headquarters disbanded.

In No. 32 Group, No. 931 Squadron was eliminated and its flights absorbed in No. 930 Squadron (Southampton) and No. 932 Squadron (Portsmouth).

In No.33 Group, the flights of No.941 Squadron (Sheffield) were taken over by No.939 Squadron, increased from 3 to 5 flights (40 balloons) and No.940 Squadron, increased from 3 to 4 flights (32 balloons). At Hull, on the elimination of No.944 Squadron, (1) No.942 Squadron was increased to 5 flights and No.943 Squadron to 4 flights.

AHB/IIA/34/5/19(A)
~~KEW/S.54584/44/~~
Org. 22 /40

No. 19 Balloon Centre

Balloon Command Form 540. Org. 4/5/40

No. 19 Centre was formed at Rosyth on the 21st October 1939, to administer Nos. 929 and 948 Squadrons. It was thought when the centre was established that existing accommodation would suffice. In practice, however, it was found that additional buildings were required and as the erection of these would involve a considerable expenditure, the Air Officer Commanding, Balloon Command, decided to eliminate No. 19 Centre altogether and it was disbanded on the 6th May 1940. Nos. 929 and 948 Squadrons were transferred to No. 18 Balloon Centre, Glasgow, and became self-accounting and self-equipping units, with balloon repairs carried out at this new centre.

/Re-organisation

(1) No. 944 Squadron was re-intrpduced on the re-organisation of the Hull barrage in October, 1940, and again eliminated in 1942. The establishment for the Commanding Officers of balloon squadrons was standardised at a wing commander for 40 or more balloons and a squadron leader for less than 40. This was retained throughout.

Re-organisation of Groups, 1940 - 1941

Balloon Command F.540 Org. 9/8/40

12/8/40

ibid. 20/8/40

ibid. 8/9/40

In August 1940, the Air Officer Commanding, Balloon Command decided that group areas should be re-arranged with a view to economising in man-power and simplifying administration. The proposals were that while No. 30 Group remained unchanged, No.31 Group would relinquish to No. 33 Group responsibility for the squadrons at Manchester, Liverpool, Runcorn and Crewe together with Nos. 8, 9 and 10 Centres, and take over the recently increased number of barrages in South Wales situated at Newport, Cardiff, Barry, Port Talbot, Swansea and Milford Haven together with Nos. 14 and 21 Centres, while No. 34 Group would administer the Newcastle and Billingham squadrons formerly controlled by No. 33 Group. These proposals, however, were not carried out except in the case of the South Wales barrages comprising Nos. 953, 969, 966, 958 and 965 Squadrons, which were transferred from No. 32 Group to No. 31 Group on the 8th September.

AHB/IID/34/4/10
~~KBO/S.54105/—~~
Ops.
Encl. 2A.
20/8/41

Balloon Command F.540 Org. Appendices B & C. 4/11/41

During the summer of 1941 a number of re-organisation projects, for reasons of economy and the co-ordination of balloon group boundaries with fighter group boundaries, were in hand including a considerable re-organisation of the groups for which instructions were issued in September. This re-organisation resulted in a reduction of the Command by one group headquarters, three centres and three squadron headquarters.

Owing to the bombing of London No. 30 Group moved from Kelvin House London to the Royal Air Force Station, Hook, taking over the premises occupied by No. 2 Balloon Centre which was disbanded, while No. 32 Group moved from Romsey to Claverton House, Bath, which was considered to be more central within the group area. No. 33 Group was re-organised, on becoming responsible for the Birmingham and Coventry squadrons on the 20th September. No. 21 Balloon Centre which had no satisfactory premises, was abolished, and the South Wales barrage, which it administered, passed to No. 14 Balloon Centre which was to become part of No. 32 Group, while No. 12 Balloon Centre with the Portsmouth and Southampton squadrons was added to No. 30 Group.

AHB/IID/34/4/10
~~KBO/S.54105/Ops.~~
Encl.17A.
5/11/41

Secret Org. Memo.627

Arrangements were made for the disbandment of No. 31 Group Headquarters on the 13th November, when the operational and administrative control of No. 14 Balloon Centre and its affiliated squadrons passed to No. 32 Group. No. 542 Squadron (Hull) was amalgamated with No. 943 Squadron. No. 7 Centre, Derby, which was neither operationally nor administratively necessary, was closed down. In London, No. 904 Squadron (Hook) and No. 909 Squadron (Chigwell) were merged with No. 903 Squadron (Kidbrooke) and No. 908 Squadron (Chigwell), the re-organisation taking effect from the 23rd August, 1941.

Changes in Establishment, 1941.

Balloon Command Form 540. Org. 19/3/41

The war situation in Spring, 1941, demanded that the most careful use should be made of all available man-power in the services, and in March, the Air Ministry Establishment Committee met at Headquarters, Balloon Command to consider possible reductions in the personnel establishment as part of the policy of conserving man-power throughout the Royal Air Force. It was considered that the number of men in a balloon crew, then fixed at 2 non-commissioned officers and 10 airmen, might be reduced to 2 non-commissioned officers and 9 airmen. At the same time a further economy could be made by doing away with

/the 10

IID
AHB/34/5/2(A)
~~KBC/S.50016~~
~~Encl. 34A.~~
M. 1 and 2.

the 10 per cent balloon crew reserve pool maintained at balloon centres. An increase in the number of balloons comprising a flight was also suggested as a means of reducing the number of flight headquarters. The introduction of tail guy mooring made balloon handling less complicated and the reduction of crews was now operationally practicable, though it would be accompanied by an increase in guard duties. At the same time it was recognised that if the Women's Auxiliary Air Force substitution, which was then under discussion, proved a failure the manning situation would be so serious that much greater reductions in crews would have to be made with consequent increase of duties and decrease of leisure time.

At the beginning of May, the Air Ministry Establishments Committee again met at Headquarters, Balloon Command, and agreed with these recommendations. In addition the number of balloon sites in a flight was to be increased from the average standard of eight in the provinces and nine in London, to up to twelve per flight with additional officers allowed for large flights, while the establishment of officers for eight balloon flights was reduced from three to two. The variation in the size of flights not only saved many flight headquarters, but eased administration by permitting flight boundaries to be drawn for topographical rather than numerical reasons. Further economies in man-power were made by reducing the training staffs at centres and the number of telephone operators working in squadrons which had no barrage control organisation.

AHB/IID/34/5/2(A)
~~KBC/S.50016~~
~~Encl. 49A.~~
19/6/41

The new establishments for all types of balloon crews were to be:-

L. Z. Balloons

	Cpls.	ACs
Land sites	2	9
Water-manned craft	2	8
One buoy (or unmanned craft)	1	3
Two buoys (or unmanned craft)	1	5

At the same time scaled establishments to suit every variation of size of flight and squadron, were prepared by Balloon Command and approved by the Air Ministry. These scales were available to all units who knew the numbers and ranks of all the personnel to which they were entitled. This publication of an approved scale created a new departure in establishment action which was later widely applied throughout the Royal Air Force. It made the many subsequent re-organizations easier and gave all concerned a feeling of fair play. During June the re-organization of balloon squadrons began on the lines agreed by the Establishments Committee.

Reduction of Establishment, 1941 - 1942

CS.12172
Encl. 1A.

In November, 1941, Air Chief Marshal Sir High Dowding, having relinquished his post as Air Officer Commanding-in-Chief, Fighter Command, had been appointed by the Air Council to review Royal Air Force establishments and recommend possible reductions to enable an overall cut of 47,000 in personnel to be made, and had prepared a memorandum on the possibility of reducing the density of balloon barrages without serious loss of operational efficiency. He was of the opinion that a 25 per cent reduction in the number of balloons flying could be made without any marked effect on the moral deterrent to enemy attack which they

/represented.

ibid.
Encl. 3A.
AHB/6D/34/5/12
~~KBC/S.51448/~~
~~Org.~~
Encl.1B.
29/11/41

represented. After considering this memorandum the Prime Minister directed that the position would best be met by a 25 per cent reduction on the manpower, rather than the balloon strength of the Command. The Deputy Chief of Air Staff (Air Vice-Marshal N. S. Bottomley) in conveying this instruction to the Air Officer Commanding-in-Chief, Fighter Command, suggested that the reduction in man-power might be made by abolishing a certain number of barrages, thinning out others, cutting the balloon crew strength from 11 to 10 and economising in administrative personnel as a result of these changes. On the assumption that the main value of the balloon barrage was to act as a deterrent, he advocated the thinning out of existing barrages rather than abolition, and added that this saving in personnel was to be independent of that made by Women's Auxiliary Air Force substitution. Calculating his available man-power at 46,372, including a certain proportion of irreducible elements which brought this total down to 43,568, the Air Officer Commanding, Balloon Command found he would have to be prepared to do without approximately 10,900 men. He proposed to make this possible in the following manner:-

ibid.
Encl.1A.
ibid.
Encl.4A.
7/12/41

(a)	By cancellation of the commitments for Eire and authorised increases of barrages which had not been made	2,134	airmen
(b)	By withdrawals of balloons from operational barrages in United Kingdom	5,203	"
(c)	By reducing the balloon crew establishment from 11 to 10 NCOs and airmen a site	1,528	"
(d)	By the saving in administrative personnel resulting from (a) and (b)	2,035	"
	Total	10,900	"

By the proposals in (a) and (b) some 667 balloons would be dis-established reducing the balloon establishment to 1,928 balloons. The particulars of balloons to be dis-established under (a) were as follows:-

Eire	100
Inchkeith	8
Pembroke Dock	24
Falmouth	6
Derby	8
Ardeer	8
Newcastle	8
Birmingham	32
	194

This left a total of 473 balloons to be found by thinning existing barrages and the Air Officer Commanding, Balloon Command had prepared plans to do this. He submitted a list of barrages from which deletions could be made which would result in a total reduction of flying strength by 473.

The Air Ministry approved these proposals, in so far as the cancellation of barrages and reduction in the strength of crews were concerned, but stated that the plans for

/thinning

AHB/IID/34/5/12
~~KBC/S.51448/~~
~~Org.~~
Encl. 6A.
3/1/43.

thinning out barrages would require the assent of the Chiefs of Staff (Anti-Aircraft) Sub-Committee. Meanwhile, other projects were being examined by the Air Ministry. These included:-

(a) The acceleration of the Women's Auxiliary Air Force substitution scheme.

(b) The formation of allied balloon squadrons recruited from foreign nationals in the country unfit for service in the field.

(c) The substitution of Indian for British personnel in overseas barrages.

Balloon Cmd.
F.540
Appendix C.
22/3/42.

In March, 1942, Headquarters Balloon Command informed groups that a number of economies in man-power had already been made by re-organisation and by reductions in certain barrages. The remaining cuts in balloon establishments had now been decided upon and were communicated. By careful reduction in the overhead administrative structure it had been found that, to secure the required reduction in man-power, it would not be necessary to thin down the barrages so radically as had been first suggested in the previous December. (1) In instructing groups to submit their recommendations for securing the reductions in barrages which were now required, the Command indicated the considerations that should govern the choice of sites for elimination. It was pointed out also that in accordance with a decision of the Chiefs of Staff (Anti-Aircraft) Sub-Committee balloons should not be withdrawn until personnel released could be absorbed into new trades. The choice of sites to be eliminated was to be governed by these considerations:-

AHB/IID/34/4/12
~~KBC/S.51442/~~
Ops.
Encl. 33A.

"(1) The effectiveness of balloon barrages is considered to be mainly moral and therefore while a thinner barrage will be less effective in actually destroying enemy aircraft, the reductions proposed will have little appreciable effect on the moral deterrent value of the barrage.

(2) Difficult sites from an operational aspect should be abandoned in favour of those where operation is easier and quicker.

(3) Sites at which tail guy mooring has been installed should be retained in preference to sites without it.

(4) Sites at which an audible lightning predictor is installed should be retained where possible.

(5) Subject to operational considerations set out above a site at which accommodation is unsatisfactory should be abandoned in favour of one with better facilities; in particular sites at which additional W.A.A.F. accommodation has been provided or is in process of erection, should be retained."

/The list

(1) In all the re-organisations, necessitated by the shortage of man-power, Balloon Command adopted the view that economies should be effected in every way possible other than by pulling down balloons.

The list of balloon establishment reductions circulated to groups was as follows:-

Barrage	From	To	Reduction
London	400	300	100
Birmingham	168	157	11
Coventry	72	54	18
Derby	32	30	2
Manchester	128	104	24
Crewe	40	30	10
Runcorn	64	48	16
Barrow	30	24	6
Sheffield	85	64	21
Langley	27	24	3
Newport	40	30	10
Swansea	36	32	4
			225

Form 540
Balloon Cmd.
2/4/42
21/4/42

This policy of reduction and re-organisation required very close collaboration between the Air Ministry Establishments Branch and Headquarters, Balloon Command, and considerable difficulty was experienced in co-ordinating the plans for a 25 per cent decrease in man-power dependent on a reduction in the number of balloons deployed with the process of W.A.A.F. substitution which demanded small units and, in consequence, a large administrative staff.

Form 540
Org.
Balloon Cmd.

In April 1942, Headquarters Balloon Command communicated to groups its recommendations for the re-organisation needed to make the reduction in the Command effective. The general purpose behind the plan was to retain the greatest degree of operational efficiency with the release of the required number of personnel. Groups were advised that certain balloons could be removed immediately, others when personnel could be absorbed. Group proposals based on these directions were to include a revised allocation of sites to flights and the particulars of sites which were to be eliminated. Any marked increase in the size of flights was to be avoided as this would make W.A.A.F. substitution more difficult.

In the case of No. 30 Group, Headquarters, Balloon Command, recommended a reduction in the London Barrage from 400 to 300 balloons deployed either in 5 squadrons of 6 flights each, or 6 squadrons of 5 flights each. At Langley 24 instead of 27 balloons were to be flown and amalgamations were suggested at Portsmouth and Southampton where two squadrons were operating in the same areas. In No. 32 Group, reductions were advocated at Swansea, Newport and Falmouth. The squadrons affected by reduction in No. 33 Group were those at Birmingham, Coventry, Barrow, Runcorn, Crewe, Manchester, Sheffield and Derby, and in No. 34 Group, barrages at Newcastle and Belfast were to be cut down in numbers, while at Glasgow an investigation was to be made into the possibility of re-organising the barrage as two squadrons instead of three.

AH8/U1/34/5/12
~~KBO/S.51448/~~
~~Org.~~
Encl.41A.
12/4/42.

As part of the process of re-organisation, Headquarters, Balloon Command offered to give up:-

No. 9 Centre, Warrington
No. 5 Centre, Birmingham North.
No. 17 Centre, Hull,

/to the Air

ibid.
Encl.61A
1/5/42

to the Air Ministry in view of the urgent need for storage space for other commands. Plans were prepared for the re-adjustment of administration which this would entail. The Air Ministry approved the suggestion, but Headquarters, Balloon Command pointed out that it would not be possible to hand over the centres until W.A.A.F. training courses were completed and the administrative arrangements concluded. No. 5 Centre was to be transferred to Maintenance Command, and No. 9 and No. 17 Centres to Technical Training Command. The balloon units formerly administered by these centres were to be transferred as follows:-

Org.Memo.514
19/6/42

Nos.911, 913 and 914/5 Squadrons to No.6 Centre (Birmingham), No.993 Squadron to No.16 Centre (Sheffield), No.922/3 Squadron to No.8 Centre (Liverpool), No.949 Squadron to No.10 Centre (Manchester) and No. 942/3 Squadron to No.16 Centre, (Sheffield).

Before general instructions for the re-organisation were issued a number of changes were being effected. These included the reduction of balloons flown by No.952 Squadron at Sheerness from 32 to 25, the dis-establishment of No.944 Squadron (Hull), and the consequent re-organisation of No.942/3 Squadron (Hull) with an establishment of 66 L.Z. balloons. No.948 Squadron (Firth of Forth) was disbanded on 15th May, 1942, and No.929 Squadron (Firth of Forth) re-organised with an establishment of 51 L.Z. balloons. No.967 Squadron (Ardeer) ceased to operate on 24th April, 1942.

AHB/IID/34/5/12
~~KBC/3.5144/~~
~~Org.1~~
Encl.80A,
21/5/42

From May, onwards Balloon Command had under consideration the detailed plans put forward by the groups for re-organisation. In the same month the Director-General of Organisation informed Balloon Command that the Director of Manning was able to make use of airmen as they were released from balloon duties. Under these circumstances the instructions for the reduction of the barrages could be issued. The details of re-organisation as approved by Balloon Command with the dates on which it was to be put into effect were as follows:-

No.30 Group

Form 540
Org.
Balloon Cmd.
Appendix E.
8/7/42

LONDON 300 balloons administered by 6 squadrons

(a) No. 1 Balloon Centre

No.901 Squadron	50 balloons	5 flights	10 balloons each.
No.902/3 Squadron (emergency barrage control)	50 balloons	5 flights	10 balloons each.

(b) No. 3 Balloon Centre

No. 904/5 Squadron	50 balloons	5 flights	10 balloons each.
No.906 Squadron (barrage control)	50 balloons	5 flights	10 balloons each.

(c) No. 4 Balloon Centre

No.907/8 Squadron (emergency barrage control)	50 balloons (Including 1 waterborne)	5 flights	10 balloons each

/No.909/10 Squadron

No.909/10 Squadron 50 balloons (Including 3 waterborne) 5 flights 10 balloons each

Reduction 100 balloons. Re-organisation to take effect from 1st August, 1942.

ibid. Appdx. O. 30/5/42

LANGLEY

No.956 Squadron 24 balloons 2 flights 12 balloons each

Reduction 3 balloons. Re-organisation to take effect from the 1st July, 1942.

ibid. Appdx.R. 31/5/42

SOUTHAMPTON

No.924/30 Squadron 63 balloons (Including 3 waterborne) 6 flights

2 flights	11 balloons	Landborne
2 flights	10 balloons	Landborne
1 flight	9 balloons	Landborne
(1 flight	12 balloons	9 Landborne) 3 Waterborne)

Reduction 11 balloons. Re-organisation to take effect from the 1st July, 1942.

PORTSMOUTH

The proposal to amalgamate No.932 and No.933 Squadrons was not proceeded with at that time.

No.32 Group

ibid. Appdx.J. 20/6/42

SWANSEA

No.958 Squadron 32 balloons 3 flights 10 balloons each

1 flight	18 balloons
1 flight	8 balloons
1 flight	6 balloons

Reduction 4 balloons. Re-organisation to take effect from the 1st July, 1942.

Org.Memo. 628/42.

NEWPORT

No.966 Squadron 30 balloons 3 flights 10 balloons each

Reduction 10 balloons. Re-organisation to take effect from the 12th July, 1942.

Org.Memo. 635/42

FALMOUTH

No.959 Squadron

This squadron had been reduced to 24 balloons with effect from the 20th March, 1942.

/No.33 Group

No.33 Group

Org. Memo 603/48

BIRMINGHAM

No.914 Squadron and No.915 Squadron re-organised as one squadron of 53 balloons known as No.914/5 Squadron, with effect from the 15th September, 1942.

No.911 Squadron re-organised on an establishment of 48 balloons with effect from the 1st September, 1942.

No.913 Squadron re-organised on an establishment of 56 balloons with effect from the 1st September, 1942.

Total reduction 43 balloons, including 32 balloons established but never flown.

Form 540 Org. Appendix K. 29/6/42.

COVENTRY

No.916 Squadron and No.917 Squadron amalgamated as No.916/17 Squadron, on an establishment of 54 balloons.

4 flights	11 balloons each
1 flight	10 balloons

Reduction 18 balloons. Re-organisation to take effect from the 25th August, 1942.

ibid. Appdx.L. 24/5/42.

BARROW

No.970 Squadron. 24 balloons

1 flight	13 balloons
1 flight	11 balloons

Reduction 6 balloons. Re-organisation to take effect from the 1st July, 1942.

ibid. Appendix G. 18/6/42.

RUNCORN

No.922 Squadron and No.923 Squadron amalgamated as No.922/23 Squadron.

No.922/23. Squadron. 48 balloons

1 flight	13 balloons
2 flights	12 balloons each
1 flight	11 balloons

Reduction 16 balloons. Re-organisation to take effect from the 11th August, 1942.

Org. Memo. 520/42

CREWE

No.949 Squadron 30 balloons.

Reduction 10 balloons. Re-organisation to take effect from the 1st July, 1942.

Form 540 Org. Balloon Cmd. Appdx.D. 12/6/42.

MANCHESTER

No.925 Squadron and No.926 Squadron each with 52 balloons deployed in:-

2 flights	11 balloons each
3 flights	10 balloons each

Reduction 24 balloons. Re-organisation to take effect from the 5th July, 1942.

/SHEFFIELD

SHEFFIELD

Form 540 Org. Balloon Command Appendix D. 12/6/42.

No.939 Squadron and No.940 Squadron amalgamated as No.939/40 Squadron.

No.939/40 Squadron. 64 balloons

4 flights	11 balloons each
2 flights	10 balloons each

Reduction 21 balloons. Re-organisation to take effect from the 25th July, 1942.

ibid. Appendix B. 2/6/42.

DERBY

No.918 Squadron. 30 balloons 3 flights 10 balloons each

Reduction 10 balloons. Re-organisation to take effect from the 1st July, 1942.

No.34 Group

Form 540 Org. Balloon Command Appendix H. 18/5/42.

NEWCASTLE

No.936 Squadron 40 balloons (including 4 waterborne)

1 flight	8 balloons	(7 landborne, 1 waterborne).
1 flight	11 balloons	(8 landborne 3 waterborne).
1 flight	11 balloons	landborne
1 flight	10 balloons	landborne

Re-organisation to take effect from the 1st June, 1942.

ibid. Appendix G. 15/7/42.

GLASGOW

No.945 Squadron 60 balloons 6 flights 10 balloons each

No.946/7 Squadron 72 balloons (including 12 Mk.VI waterborne)

2 flights	12 balloons	each
2 flights	10 balloons	each
1 flight	8 balloons	each
1 flight	8 balloons	and 12 Mk.VI balloons

Re-organisation to take effect from the 1st August, 1942.

ibid. Appendix P. 30/5/42.

BELFAST

No.968 Squadron 32 balloons

2 flights	11 balloons	each
1 flight	10 balloons	

Reduction from 40 L.Z. balloons and 20 Mk.VI balloons to 32 L.Z. balloons.

Form 540 Org. Balloon Command 26/7/42. Appendix K. 26/8/42 Appendix G. 28/8/42. Appendix F.

Arrangements were completed for handing over the three balloon centres. Maintenance Command assumed responsibility for No.5 Centre on the 1st August, 1942; Technical Training Command took over No.9 centre on the 15th September, 1942. On the 15th October, 1942, No.17 Centre ceased to operate as a balloon centre and became the squadron headquarters of No.942/3 Squadron and was also to accommodate a unit of Technical Training Command.

"M" BALLOON UNIT

S.46550 Encl.1 14.9.38. (DESTROYED)

Shortly after the Munich crisis in 1938, the Air Officer Commanding-in-Chief, Bomber Command (Air Chief Marshal Sir Edgar Ludlow-Hewitt) wrote to the Deputy Chief of the Air Staff, asking whether any steps had been taken for the production of suitable propaganda leaflets for release over hostile territory in the event of war and suggesting that:-

> "skilfully dropped propaganda, distributed by aircraft, might prove a more potent weapon than bombs."

ibid. Encls.1A, 5A, 6A.

This suggestion was passed to the Committee of Imperial Defence (Major General Hastings Ismay), and the whole question of propaganda was taken up as a matter of the utmost urgency by the Foreign Office. The proposal was later approved by the Air Staff.

ibid. Encl.12A.

Successful experiments were carried out by Bomber Command at Mildenhall, and in a letter to the Deputy Chief of the Air Staff, reporting on the progress made in dropping leaflets from aircraft, Air Chief Marshal Ludlow-Hewitt made the suggestion that owing to possible reprisals being taken against pilots who were captured on leaflet flights, balloons might be used, similar to those used in the last war.

ibid. Encl.16A.

S.46546 Encl.16A.

At the end of August 1938, all investigations into the means of disseminating propaganda from the air were being undertaken by the Air Ministry, Plans 5 (Wing Commander D.L. Blackford), and in a "Memorandum on the use of the Royal Air Force for dropping Pamphlets in Enemy Territory" issued on the 10th October 1938, appeared the first description of a special propaganda balloon unit and its proposed establishment. The Director of the Balloon Development Establishment at Cardington was asked to explore the possibility of designing and producing a balloon capable of six or more hours flying and carrying approximately 6,000 leaflets.

S.1497 Minute 1 10.6.39.

In May, 1939, at the 35th Meeting of the Deputy Chiefs of Staff, it was decided that the formation of a balloon unit for this purpose should be proceeded with for employment with the French balloon companies.

S.47694 Encl.10A and Minute 8.

ibid. Minutes 44 and 45.

The Balloon Development Establishment had by March 1939, designed and successfully flown a balloon, fulfilling the requirements called for in a "Memorandum of Requirements for Balloons for Leaflet Distribution" and by June a simple and reliable release mechanism had been produced. During the experiments the balloon equipment had been termed "P" = propaganda, but it was agreed that "M" = meteorological would cause less curiosity, and from this designation the Unit later took its name.

S.1497 Minute 3.

S.1497 Minute 6.

On the 14th June 1939, the Director of War Organisation was asked by the Air Staff to make suitable arrangements to form, on mobilisation, a special balloon unit, on the lines of the provisional establishment drawn up during August, 1938. Arrangements were made for the Unit, less transport to proceed to France in the Advance Party ship on Z+2 day, where it would be attached to the French balloon companies until the arrival of the transport. Nancy was suggested as the most suitable area from which to operater.

/During the

During the last fortnight of August 1939 the personnel of the Unit were gradually transferred to Royal Air Force Station Cardington to undergo training in handling "M" type balloons and equipment. At this time the Unit consisted of one Officer and 20 airmen, formed into four sections of four men each, together with M.T. drivers and Clerks. With this establishment it was anticipated that about 36 balloons could be released each hour given suitable conditions. On the 30th August, 1939, the Unit was order to move to Royal Air Force Station, Abingdon, to be held ready for immediate despatch to France.

S.1497/W.O.3 dated 30.8.39.

OPERATIONS IN FRANCE

On the 31st August an initial supply of balloons and equipment was despatched to the Officer Commanding, Balloon Group, French Army at Epinal, and on the 2nd September the Unit moved by road to Southampton and embarked with the first contingent of the Advanced Air Striking Force. On disembarking at Le Havre, the Unit proceeded by road to the village of Foug near Toul, a few kilometres from Nancy, where a suitable site had been selected. The aerodrome at Toul-Croix-de-Metz was selected as the terminal airport for supplies to the Unit, which was now administered by Headquarters, Advanced Air Striking Force.

S.47694 Minute 77

Letter S.1497/ W.O.3 30.8.39.

The site proved to be very isolated and there were many administrative difficulties but the Unit was sufficiently organised by the 1st October to carry out its first operation. This was somewhat experimental and sixty balloons were launched carrying 180,000 leaflets for destinations one hundred miles inside Germany.

Report BC/S.20508/ Int. 2.10.39.

In the middle of October the weather made it impossible to continue operations from the site at Foug, which had become waterlogged and was unapproachable by road. A move was authorized to the village of Schickenbusch near Sarrebourg where the Unit was installed in more suitable quarters in a chateau, and a hangar on Buhl aerodrome was placed at its disposal for operational gear. A launching site was cleared in a small wood and operations were continued from here until May 1940. An average of 60 releases were made on each opportunity, and in all some 4,516,000 leaflets were sent from this site. The Unit was supplied with balloons and leaflets by air from England, and hydrogen was provided from French sources at Epinal, in a mixture of British low pressure and French cylinders. Owing to the proximity of the German frontier, it was possible to use leaflets instead of ballast bags, but these had to be punched by hand - a considerable undertaking.

S.2256 Encl.4A 16.10.39.

Operations from Kent

On the 17th May 1940, owing to the military situation, it was decided to withdraw the Unit from France, and it proceeded via Cherbourg and Dover to Royal Air Force Station, Uxbridge, to refit and thence to Royal Air Force Station, Cardington, where it was reformed and transferred to Balloon Command.

S.1497 Signal W.56. to H.Q. B.A.A.F. 17.5.40.

ibid. Sigs. O.272 and O,924.

Royal Air Force Station, Manston, was selected as the new site for the Unit, mainly on account of its geographical situation which enabled the best use to be made of the prevailing west and north-west winds. The unit arrived there on the 5th July, suitable accommodation for both personnel and their equipment being provided on the station. On the 14th July, 1940, a signal was received from the Air Ministry to the effect that operations were to commence as from 2000 hours on that day.

ibid. Sig.O.951 4.7.40.

S.2256 X.13 14.7.40.

/With all

With all Western Europe occupied by the enemy it was now possible for the Unit to operate over a very much wider area than hitherto. Confiscation of radio sets, the ban on listening to foreign broadcasts and the strict control of newspapers, made it important that the people of the occupied countries should, by other means, be kept in as close touch as possible with current events abroad. The Political Intelligence Department of the Foreign Office, responsible for all propaganda in enemy and enemy-occupied territory, were producing special newspapers for France, Belgium and other occupied countries. At this time, the number of aircraft available were insufficient to undertake special flights for the sole purpose of dropping leaflets. The great quantity of leaflets which were dropped by the aircraft of Bomber Command were only incidental to bombing operations, and so the area affected was small. Here "M" Balloon Unit was of special value, since it was possible, by using every available wind, to send both newspapers and leaflets to Germany, France, Belgium and Holland, and to areas rarely covered by operational aircraft.

Log Book Entry by Flt.Lt.Elton and Unit Operational Return - Form M.P.1 dated 17.7.40.

The first balloons were released from Manston on the night of the 16/17th July, 1940, for destinations north-west of Paris and operations continued until the middle of August when the Luftwaffe began large-scale attacks against fighter airfields in this country. Manston was singled out for attack at the start of the Battle of Britain, and on the 24th August a very heavy dive-bombing attack started late in the morning. The hangar and stores used by the Unit received two direct hits with medium bombs and were set on fire. Fortunately no personnel were injured but all the equipment was lost with the exception of a 3-ton lorry, a 15-cwt van and a pair of scissors. Four airmen (1) of the Unit showed considerable bravery in entering the burning hangar and removing hydrogen trailers to safety under machine-gun fire.

No.1 Balloon Centre signal A.82 dated 18.9.40.

Balloon Command Signal to A.M. A.919 11.10.40.

Since the Unit now had no accommodation, and as more attacks were expected, alternative temporary billets were found in the village of Birchington, about three miles from Manston. After a period spent at No.1 Balloon Centre, Kidbrooke, to refit, another site was found at Birchington - Grenham House School. This was occupied on the 19th September, 1940. The School House provided excellent accommodation, and a satisfactory launching site was made in the school grounds The Unit was again ready to operate on the 11th October 1940.

The time taken to refit the Unit coincided with a period of unsettled weather and it was not until the night of the 31st October that the first operation was made from Birchington. Due partly to a small increase in personnel, but mainly to the convenience of the site, it was possible to increase the output considerably and an average of 1,500,000 leaflets a month were disseminated. In February, 1941, a record figure of 3,062,000 leaflets and 1,407 balloons were released.

DEVELOPMENT IN "M" BALLOONS.

Up to this time, it had been the policy to fly as many balloons per operation as was thought practicable by the Commanding Officer (Fg.Off. J.M. Woodcock), who was solely responsible to the Air Ministry (2) for the operational work carried out by the unit, but it was now considered that two hundred balloons per operation should be regarded as a minimum.

/Practical

(1) F/S Price, Sgt Topps, Cpl McNeill and LAC Quayle were commended by A.O.C. Balloon Command for their prompt and plucky action.

(2) A.M. Branches concerned were Plans 5, later P.R.7, later Deputy Directorate of Counter-propaganda.

Practical experience had enabled the Unit to speed up the inflation and release of balloons, and given the best possible conditions it was found that, by employing three crews of seven men, one balloon could be inflated, loaded and launched every forty seconds.

Several airmen in the Unit were keenly interested in the work, and experimented on their own account, the most successful being the modification of the Mark II release mechanism. This modification was designed for short-range work of five hours flying or less, at the same time carrying the maximum load of leaflets. Approved by the Balloon Development Establishment in November, the new mechanism was put into production as the Mark III release, and was in constant use until the disbandment of the Unit.

S.547694 Encl.194A.

In July, 1941, Dr.H.A. Thomas of the National Physical Laboratory, visited the Unit in connection with the experiments he had been conducting from H.M. Balloon Station, Mousehole, Cornwall. To help him in his research work he was invited to examine the weather forecasts supplied to the Unit during the preceding six months, and his conclusions were published in "Statistics of Operations for January - July 1941". It was found that the meteorological reports which were being prepared for the Unit gave insufficient information and that the wind directions given was often at variance with later knowledge. It was accordingly arranged that the Unit should be furnished by the Meteorological Office, Air Ministry with a special report to be known as the "Papyrus" forecast, which would embody all essential weather and wind data up to approximately two hours before the release of balloons.

MBU/S.1950/2/ Ops.

Synoptic Special Instruction No.13 MBU/S.800/ 2/Met.

The new service started on the 24th November, 1941.

In July 1941, a report (1) was issued by the National Physical Laboratory giving a detailed account of the research work carried out by Dr. Thomas. Since 1939, experiments had been carried out to produce a reliable balloon capable of carrying leaflets over the Continent which would at the same time be inexpensive and easy to produce in quantities. Besides the "M" type equipment, the Admiralty had been using a latex balloon similar to that used in the Free Balloon Barrage (Operation Albino), (2) but employing a liquid ballasting device in place of sand ballast to maintain a constant height. The National Physical Laboratory, had also developed a balloon with a ballasting device controlled by the gas pressure in the envelope.

S.47694 Encl.188B.

At a meeting at the Ministry of Aircraft Production in September 1941, it was decided that comparative trials should be flown to determine which type of balloon was the most efficient.

The trial flights commenced in February, 1942 over the British Isles, but before they were completed, it became apparent that no definite result was likely to be obtained, and they were abandoned. Some useful information was, however, obtained and the results were embodied in a short summary and maps issued by the unit. It was found that the "M" type balloon was equally as efficient as the other types, and it was decided to retain the design. In April 1942, however, the shortage of rubber became acute and the Balloon

CSB.44307 Ref. Bal/206/R.D. Arm.7 21.4.42.

/Development

(1) "An Interim Report on Controlling the Height of Free Balloons." File: MBU/S.1950/1/OPS.

(2) See Section 22.

Development Establishment was asked to find an alternative proofing. Several were tried without success, the most promising being nitro-cellulose. A small number of balloons was made and proved very successful under test, but they were not put into production owing to the uncertain future of the Unit.

FURTHER OPERATIONS FROM KENT

DDCP/60 Minute from FO.1 to PR.7. 20.1.42. Balloon Command letter ~~KBC/S.53483/127/Org.~~ 9.3.42. DESTROYED

Balloon Command postagram ~~KBC/S.53483/143/Org.~~ 10.6.42. DESTROYED

Towards the end of 1941, night interception by our fighter aircraft was rapidly increasing, and it was clear that operations from Birchington would be impossible owing to the proximity of Manston airfield, over which prevailing winds drifted the balloons. Instructions were received from the Air Ministry to find another site, preferably between Folkestone and Dover, in which/area there was little or no night flying. In January 1942, a large country house - General's Meadow, Walmer - was found suitable for the purpose. After certain necessary work on the site had been completed the Unit took over occupation on 11th June, 1942.

During the previous few months the number of balloon releases had again been raised, this time to 350 per operation. This later had to be reduced to 200 owing to shortage of reserves and production difficulties with the new nitro-cellulose fabric. However, between the 1st December, 1942, and the 31st July, 1943, 11,000 balloons were released and 25,000,000 leaflets and books distributed over France and Germany. In February, 1943, all previous records were broken when 5,391,000 leaflets were disseminated by 2,478 balloons.

In August, 1943, the Unit was given the task of disseminating special types of leaflets needing only a small distribution. This fitted in well with the shortage of balloons, which was becoming acute. At the end of June, 1943, however, a quantity of the new balloons was delivered, the first being used on the 3rd January, 1944. These balloons were not very satisfactory at first, several only flying for an hour or two before coming down. This entailed that every balloon had to be examined for leaks after inflation, which greatly retarded the rate of release. Operations were continued, however, and in June, 1944, releases were made on seventeen nights, 1,327 balloons being despatched with 3,041,290 leaflets.

RETURN TO THE CONTINENT

By September, 1944, the area over which the Unit could operate was considerably reduced by the advances of the Allied armies, and it was decided that the Unit should be moved to the Continent to continue operations over Germany. A preliminary reconnaissance was made by the Commanding Officer and the Quartering Branch of No.84 Group and a site found at Bunsbeek, a small village near Tirlemont, Belgium. Here part of a Roman Catholic Girls' School was taken over for living accommodation, and a large hall in the village requisitioned for stores, workshops, dining hall and cookhouse.

Letter KBC/~~S.53483/~~ 7.11.44. DESTROYED

The Unit was transferred from Balloon Command to 2nd Tactical Air Force on the 15th November, 1944. An Advance Party consisting of a Sergeant and five airmen was dispatched on the 13th December to prepare the site and to receive the stores which were shipped under the care of two

/other airmen.

other airmen. The Main Party left Walmer at 0300 hours on the 31st December by road and arrived at the Transit Camp, Hornchurch during the afternoon. There was a lapse of some four weeks after the unit's arrival on the continent, before favourable weather enabled the first release to be made; however, during February it was possible to carry out eight operations.

As the days passed the area over which leaflets could be disseminated became smaller, so that in March only four operations were possible and in April only three, with the result that on the 27th April instructions were received to cease operations. On the 18th May the Unit was withdrawn to No.159 Balloon Wing (the parent Unit) at St. Nicholas for disbandment.

A.X.446
A.M.Signal
27.4.45.

At the time of its disbandment, No.1 "M" Balloon Unit had been in existence for five years and ten months, during which time 57,863 balloons had been launched and 94,935,830 leaflets distributed over Germany, France, Belgium and Holland.(1) This number of leaflets represents a fifteenth part of all the propaganda leaflets distributed by the Royal Air Force during the period of hostilities in Europe, and included 130,323,635 special type leaflets and booklets.

Major-General Bishop, Deputy Director General of the Political Intelligence Department of the Foreign Office wrote to the Assistant Chief of the Air Staff (General) (Air Marshal Sir Richard Beck) on the 26th April, 1945 -

41D/23
DDG/79
26.4.45.

> "I see that upon the occasion of the Unit's transfer to the Continent, Major-General Brooks took the opportunity of placing on record our high appreciation of this Unit's magnificent contribution to political warfare and I should now like to add my personal thanks for their continued efforts in difficult and trying circumstances. In view of the Political Warfare Executive the Commanding Officer and all ranks have every reason to feel proud of their achievements".

/SECTION 20

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(1) See Appendix "B".

SECTION 20

BALLOON PROTECTION OF THE MURMANSK CONVOY

Although it had been decided at a conference at the Admiralty in April, 1941, that balloons would be supplied for the protection of ocean-going ships as well as for those plying round the coasts, it was not until May 1942, that Admiralty approval was given for British and European Allied merchant ships leaving the United Kingdom and sailing in convoy to Murmansk to be given balloon protection. It was laid down that on leaving this country, the ships would not fly balloons, but each would be issued with two deflated Mark VI balloons in valises, together with ten cylinders of hydrogen, the necessary inflation equipment and a bedding-down net.

A.M./S.80773
Encl.1A.
16.5.42.

The intention was that on arriving in an area where air attack was possible, one balloon would be inflated, and bedded-down on deck under a net. On an air attack becoming imminent the balloon would be flown to operational height. It was thought unwise to fly the balloons the whole time, owing to the possibility of revealing the position of the convoy to enemy submarines or surface craft.

The principal ports concerned were Glasgow, Leith, Newcastle and Hull, and to a lesser extent Sunderland, Middlesborough, Cardiff and Liverpool. Arrangements for the supply of balloons and ancillary equipment were made by the Admiralty from their resources, and for the supply of hydrogen and cylinders by Balloon Command.

The number of cylinders of hydrogen allowed permitted the inflation of the two balloons and some degree of topping up. The necessary inflation equipment was already in the possession of the Royal Navy and the Air Ministry were requested to make available 1,000 cylinders. It was estimated that this number would be required for the number of ships involved (100, taking into account the period of "turn-round" of the voyages.

ibid.
Encl.3A.
16.5.42.

Groups were instructed to make all arrangements for the supply of hydrogen to these merchant ships at the ports concerned in their areas, and a further thousand cylinders were added to the initial equipment of Balloon Command for this purpose.

ibid.
Encl.5A.
23.8.42.

In August, 1942, however, Balloon Command drew the attention of the Air Ministry to the fact that already the original allowance of 1,000 cylinders had been exceeded, and that the demand was continuing. Up to that time, 1,333 cylinders had been issued to the ships and only 180 had been returned. The hydrogen cylinder situation in the Command was already taxed to dangerous limits by reason of the various extra demands which had been made for unforseen commitments, so that immediate additional provision was required if the supply to the Russian convoys was to continue.

ibid.
Encl.10A.
8.9.42.

The Admiralty were notified of the position and were informed that their requirement had been met by cutting down Balloon Command's operational value in the Home Defence programme. This obviously could not continue; in addition, the fact was stressed that cylinder requirements for future operations in Europe had not been covered. Whilst the importance of providing all that was possible for the Russian convoys was recognized, this could only be carried out with the material available at the expense of other commitments. Information was, therefore, requested as to the total requirements of cylinders to be established to cover the Russian convoy in addition to the number required by the Admiralty

/for shore

for shore Servicing Stations in home waters. (1)

In reply, the Admiralty estimated that an additional 2,500 cylinders would now be required for this commitment, and although it was not known for how long the commitment would last, the Naval Staff were, at that time, considering the value of balloons on the Russian convoys, and any decision to dispense with such balloon protection would be notified to the Air Ministry immediately.

ibid. Encl.18A. 25.9.42.

Balloons continued to be flown by vessels on the convoys, however, until the final cancellation of such policy for all merchant ships at sea was received from the Admiralty in November, 1944.

Shore Servicing Station at Murmansk.

During September also, it was proposed by the Admiralty that a balloon servicing station, manned by Royal Air Force personnel, should be established at Murmansk, because the existing arrangements for the convoys did not always ensure the availability of balloons for the return voyage as all the hydrogen was frequently expended on the outward trip. The Russian authorities had also suggested that ships should have balloon protection whilst lying in harbour, which of course would also require the provision of hydrogen at Murmansk.

ibid. Encl.13B. 8.9.42.

The Royal Air Force personnel, trained to operate a portable silicol plant, as well as servicing the Balloons, could be made available. Also 100 hydrogen cylinders could be supplied, in addition to the existing float of 1,000, should it be found possible to provide a compressor at Murmansk. If the latter could not be provided, supply by "nurse" balloons would be necessary.

ibid. Encl.13A. 10.9.42.

At the end of the month, the Air Ministry was informed that no compressors suitable for the requirement at Murmansk were available, but that an A.2 silicol plant with chemicals could be provided, and therefore "nurse" balloons would be required for transferring the hydrogen from the plant to the balloons.

ibid. Encl.22A. 30.9.42.

Defence of Murmansk Harbour.

On the 1st January, 1943, a signal was received at the Admiralty from the Naval Officer in Charge, Murmansk, stating that there had been intermittent air raids on the town and the docks during the past thirty-six hours. There were no British or American casualties, but one Russian ship had been flooded aft. An early decision regarding the supply of a balloon barrage at Murmansk was therefore requested.

ibid. Encl.34A. 2.1.43.

A Russian balloon barrage arrived at Murmansk shortly after the raids, but was only for covering the dock area. It was necessary for ships at anchor in the harbour to fly balloons as protection during the whole length of their stay. This made local replenishment of hydrogen supplies doubly essential. Also local servicing facilities would have to be provided to maintain a continuous ship-borne barrage, making necessary the early establishment of a shore servicing station.

/The Naval

(1) See page 337.

ibid. Encl.37A. 7.2.43.

The Naval Officer in Charge, Murmansk, was therefore instructed by the Admiralty to make maximum use of Russian balloon facilities, and in the meantime to ascertain if local hydrogen was available for ships' balloons, after the Russians' own requirements had been met; also whether facilities were available locally for handling and recharging ships' hydrogen cylinders, or whether ships' balloons could be topped-up ashore from "nurse" balloons.

ibid. Encl.39A. 14.2.43.

A reply was received to the effect that the Russians could supply hydrogen, but would not state the quantity available, and also that they could inflate ships' balloons ashore, but not the hydrogen cylinders.

There was some reluctance on the part of the Russian Naval Staff at this time to allow merchant vessels to fly balloons in Kola Inlet, as they feared danger to Russian fighter aircraft, but after some discussion they agreed to the flying of ship-borne balloons in the vicinity of Murmansk, these ships to make use of Russian hydrogen and maintenance facilities. These water-borne balloons in addition to the Russian shore-based barrage fulfilled the defence requirements for the docks.

ibid. Encl.42A.

In March, 1943, the Naval Officer in Charge, Murmansk, interviewed the Commander of the Murmansk anti-aircraft guns and conveyed to him the grave concern of the Senior British Naval Officer, North Russia (Admiral Miles) regarding the inadequate number of shore balloons being flown to counteract low-level enemy attacks. An offer was made to send for a supply of land type balloons for the defence of the docks, to replace any lost through weather or gunfire, but the Russians insisted that they had a plentiful supply of balloons and that these balloons would be flown whenever weather conditions made low-level attacks probable. The defence of Murmansk harbour was therefore, left entirely in the hands of the Russians; ships flying balloons while they were lying at anchor as an additional measure. As both the supply of hydrogen and all maintenance could be provided by the Russians, the establishment of a British shore servicing station at Murmansk became unnecessary, and the scheme was abandoned.

/SECTION 21

SECTION 21

OPERATION 'OUTWARD'

AHB/IID/34/4/14
~~KBO/51569/~~
Ops. Encl.1A.

On the 21st February, 1940 the Air Officer Commanding Balloon Command suggested in a letter to the Air Ministry the possibility that valuable results might be achieved by flying small balloons over enemy territory, to each of which would be attached a length of cable trailing on the ground. He pointed out that since the outbreak of war considerable damage had been done in this country to the electricity services by balloons which had broken away from their moorings. This scheme, however, did not meet with the Air Ministry approval; they considered that the idea, apart from being uneconomical, was not practicable in the light of the rarity of targets and the lack of adequate meteorological data.

ibid.
Encl.2A.

No further developments took place until the 13th October, when the Air Officer Commanding, Balloon Command, again wrote to the Air Ministry forwarding a paper on the subject written by one of his staff (Sqn.Ldr. J.H.L.B. Davies). This paper endeavoured to put the scheme on a practical and economical basis. It pointed out that considerable damage had been caused in Finland and Sweden as well as in this country, emphasising the fact that although the actual physical damage did not appear to be great, the consequent damage such as loss of production, inconvenience and the general hampering of the German war effort was considerable. Once again this suggestion was turned down.

ibid.
Encl.3B.

The Chiefs of Staff at their 324th Meeting held on the 25th September, were unable to recommend the use of balloons as an offensive weapon. It is quite obvious from the dates that they had had the matter under consideration before the second proposal was submitted by Balloon Command. It emanated from a Minute from the Prime Minister; whether he based his minute on Balloon Command's first proposal or whether other information had come before him from another source is a matter of conjecture.

A number of points were stressed at the Chief of Staff's meeting, the outcome being that the Committee decided to invite the Air Ministry to circulate a report on the subject, dealing specifically with certain points which are set out below.

ibid.
Encl.5A.

(i) To what extent were overhead power lines and telegraph lines in Germany vulnerable to interruption in this way? In what areas of Germany were such cables particularly suitable for attack?

(ii) There would be a tendency for most of the balloons released in this country to drift north-west in accordance with the prevailing direction of the wind. How many days per year would wind conditions make it possible to attack the vulnerable areas in Germany by this method?

(iii) The employment of this form of attack might well cause retaliation. To what extent were vulnerable areas in this country open to attack from German-occupied territories or on how many days of the year?

(iv) What modifications in present design would be necessary in the light of pre-war experience, to enable the balloons to be used effectively for this purpose?

/(v) To what

(v) To what extent would the production of such special balloons, and the necessary cable attachments, interfere with barrage balloon production which was already being used to capacity for defence requirements?

Again the whole subject seems to have been shelved, until the 14th March 1942, when out of the blue came a letter from the Director of Boom Defences, Admiralty (Capt. G. Banister) referring to an operation appropriately known as 'Outward'. (This operation was approved by the Chiefs of Staff at their 71st Meeting held on the 4th March 1942). The Director of
CS/13790 Boom Defences explained to Headquarters, Balloon Command, the
Encl.4A. functions of 'Outward' and it was apparent that this operation was identical in many respects to the proposal submitted by Sqn.Ldr. Davies in October 1940. Having explained 'Outward' the Director of Boom Defences concluded by asking the Air Officer Commanding whether in the event of certain apparatus being supplied to balloon centres, releases could be under-taken by Air Force personnel. Arrangements were accordingly made for a number of staff officers from Headquarters Balloon Command, to attend a release of balloons from Felixstowe, in order that they might be in a position to decide to what extent releases from certain barrage areas would be practicable.

The functioning of 'Outward' was similar to that of the
AHB/IID/34/4/14 release of balloons in operations 'Albino' (1) and 'Petard' (2).
~~KBO/51569/Ops.~~ The balloons were fitted with a special ballasting device
Encl.5A. for long distance flying with a view to their descent in enemy country; they carried no explosive or lethal equipment but had 700 feet of string attached to a 300 foot length of 15 gauge iron wire. Under the Naval organisation 4 men or women were employed in servicing each release hut, and would be able to deal with at least 10 balloons per hour. The scale of release, amounting to about 1,000 balloons in 4 hours from any given centre, was considered to be quite adequate.

Following reports from the staff officers who visited
ibid. Felixstowe, the Air Officer Commanding, Balloon Command,
Encl.3A. notified the Director of Fighter Operations, that it was well within the Command's capacity to carry out the wishes of the Director of Boom Defences, Admiralty, but pointed out that before any releases were made sanction would have to be given by the Air Ministry.

The next urgent request to Balloon Command came in July, 1942 when the Director of Boom Defences asked that a supply of hydrogen be allocated for an operation in the vicinity of Ringmould, Kent, in addition to the supply provided for Felixstowe. This request was too much for the already over-taxed hydrogen organisation, the limiting factors being as much the shortage of hydrogen cylinders as prime-movers for towing the trailers. Under these circumstances the
ibid. authority of Fighter Command was sought to cancel the
Signal 9A. 'Albino' operation in certain areas, until such time as either operation was completed or new cylinders were available. Fighter Command sanctioned the withdrawal of a number of hydrogen cylinders from the Hull area.

/thus

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(1) See pp. 403-406

(2) See pp. 406-410

Thus 'Outward' came into being, but definitely as a naval child. Balloon Command's chief job was to supply the hydrogen, the demand for which increased as the months went by. The original request, in July, for the balloon release at Felixstowe was for 13 prime-movers and 1,000 hydrogen cylinders. This was increased by another 12 prime-movers and another 1,000 cylinders for Ringmould. By October the figures had reached 40 prime-movers and just under 4,000 hydrogen cylinders. However, the naval authorities had convinced the Chiefs of Staff of the success of the operation and their demands were met until such time as operations 'Overlord' and 'Diver' commenced, when supplies were cut to the minimum.

ibid.
Encl.30A.

It is appropriate to mention at this stage that during the initial stages and, for that matter, well into its career, 'Outward' was not blessed by Bomber, Fighter or Coastal Commands. They were all very much concerned with the safety of their own aircraft and continued to put forward the argument that this factor far outweighed the small effects the balloons would be likely to have against enemy installations. It was quite understandable, therefore, that having once obtained assurance from the Admiralty that the apparatus used would have little or no effect on our aircraft, the suggestion of incorporating bombs in the units of the 'Outward' apparatus brought about very strong objections, with the result that in a letter to the Admiralty dated the 11th June, 1942 the Air Council pointed out that:-

CS/13790
Encl.40A.

> "...To fit 'Albino' type bombs to the apparatus would, in fact, turn the operation into one as meanacing as 'Albino' or 'Petard', both of which are considered to be a danger to our own aircraft....."

However, in spite of all the protests the Naval authorities won half the battle and were allowed to attach to their balloons incendiary bombs similar to those used in the 'Petard' operation, mainly because Operation 'Petard' was controlled and operated by Fighter Command, who thought it a successful venture.

On the 11th May, 1944, instructions were issued from Headquarters, Air Defence of Great Britian, to Nos.11 and 12 Groups changing the policy of 'Outward'. Hitherto, it had been customary for the Naval authorities to release balloons only under the strict operational control of the Air Force Commands concerned, owing to the very large number released at a time, thereby causing danger to friendly aircraft and interfering with operations. Consequently, permission to put the operation into effect had, more often than not, been refused. It had now been agreed between the Admiralty and the Air Ministry that the present arrangements should be considerably modified by the introduction of a new method known as the uncontrolled "trickle" release, whereby, when the wind was favourable, 'Outward' balloons were released:-

(i) continuously at the rate of approximately one balloon every ten minutes;

(ii) with not more than two percent carrying trailing wires;

(iii) with the remainder fitted with incendiary material only, thus reducing the danger to friendly aircraft to a minimum.

The Naval authorities were, therefore, relieved of the responsibility of obtaining prior permission from the Royal Air Force. This policy remained in force until 'Outward' was discontinued in September, 1944.

/SECTION 22.

SECTION 22

THE FREE BALLOON BARRAGE

Introduction

In the autumn of 1940, the Admiralty put forward a plan for using a free balloon barrage as an aerial minefield. The idea was to release a large number of small balloons either on routes generally followed by hostile aircraft or over objectives which they were expected to bomb. To these small balloons a trailing cable of some 2,000 feet of thin wire was attached, with a bomb fitted to the upper end and a drogue parachute to the lower. When an aircraft struck this cable the balloon would break away and the bomb would detonate on being brought into contact with the aircraft by the drag of the parachute. The height of the balloon was controlled by a lighted fuse which first burnt through a cord and released the spool of cable and then set free small ballast bags to compensate for loss of gas through valving. Finally, the fuse operated a self-destruction device.

Proposals for a Free Balloon Barrage.

S.6866.Pt.I
Encl.10A.
10.10.40.

At a meeting of the War Cabinet on the 7th October, 1940, the following conclusion was recorded:-

> "The Secretary of State for Air should be invited to consider the use of balloons with mines attached as a weapon which can be used against enemy bombers attacking this country when weather conditions such as fog make it impossible for our fighters to leave the ground".

ibid.
Encl.4B.
21.10.40.

Later in the same month at a meeting called by the Prime Minister (Mr. Winston Churchill) to consider Night Air Defence, the Third Sea Lord reported that the Admiralty had devised a free aerial mine comprising a hydrogen balloon carrying a cable, bomb and parachute which would go to any height required up to 35,000 feet. The meeting agreed that the moral effect of flying such balloons on nights when our fighters could not operate would be very great and instructions were given for the orders for such units to be greatly increased. The details of the operation were discussed at a conference held at the Air Ministry on the 29th November. It was envisaged that the release of some 3,200 balloons from 40 points on a 10 mile front would constitute an effective aerial minefield over an area of 53 miles by 15 miles at a height of between 14,000, and 22,000 feet. Approximately 1,024,000 cubic feet of hydrogen would be required for an operation of this kind.

ibid.
Encl.46A.
29.11.40.

The conference decided to carry out an experiment in the use of the Free Balloon Barrage in the defence of London extending over a period of about eight weeks. Balloon Command would provide the men, hydrogen, cylinders, trailers, communications and a proportion of the transport. The barrage would be under the operational control of the Air Officer Commanding-in-Chief, Fighter Command, and a special meteorological officer would be attached to his Headquarters, to advise him when conditions were favourable for the operation of the balloons. The National Physical Laboratory was to assist in plotting the course of the balloons, which would be supplied from Admiralty resources. The barrage would only be used at night and in areas where fighter aircraft were not operating. Balloons would not be released in conditions of deep cloud layer accompanied by ice and snow, nor in ground winds exceeding 20 miles an hour. It was considered that such

/a barrage.

a barrage would be effective in upper wind speeds of 5 - 30 miles an hour, but no greater. A warning note was sounded by the Air Officer Commanding-in-Chief who pointed out that the operation of the Free Balloon Barrage might entail a heavy drain on the operational resources of Balloon Command.(1) The project of releasing 1,600 free balloons over a four-hour period twice a week entailed 2,220 hydrogen cylinders and 74 trailers, 37 prime-movers and 33 lorries, while 310 airmen and 3 officers would be involved. Nevertheless, the Director of Home Operations recommended the scheme to the Deputy Chief of the Air Staff pointing out that it would, at least, constitute some form of defence when fighters could not take the air and guns were ineffective.

ibid.
Encl.47A.
4.12.40.

> "The size of the barrage would be 55 miles long, 7 miles wide and 4,000 feet deep. This will be another hedge for the bomber and I hope a useful one."

The London Experiment

ibid.
Encl.86B.
6.12.40.

At the beginning of December, 1940, Headquarters, Balloon Command issued instructions to No.30 Group to organize the Free Balloon Barrage unit. It was to be set up on a mobile basis in four detachments, each consisting of 1 officer, 5 non-commissioned officers and 50 airmen, based on the four London balloon centres. The complete unit would operate in one of four sectors of a circle of about 25 miles radius from Charing Cross, depending on weather conditions and the direction of the wind. The four sectors, south-east, south-west, north-west and north-east corresponded to the four balloon centres. When weather was considered to be favourable for Free Balloon Barrage operations, the unit would be concentrated at the balloon centre from which the night's operation was to take place, and would later in the day take up its position on the appropriate front in the sector from which the release was to be made. Balloons would be released from 20 sites, each comprising 2 filling points, each site being manned by 1 non-commissioned officer and 10 airmen.

ibid.
Encl.88A.
10.12.40.

ibid.
Encl.100A.
13.12.40.

Other commands were warned of the impending operations and of the possibility of units reaching the ground in a dangerous condition.

ibid.
Encl.109A.
14.12.40.

On the 14th December, the Air Officer Commanding-in-Chief, Fighter Command, was able to inform the Air Ministry that equipment sufficient for the experiment was in course of delivery to Balloon Command and that all preparations would be completed by the 16th December. An operational order for the deployment of the Free Balloon Barrage under the code name of "Pegasus" was issued by Fighter Command. The barrage would be flown in accordance with meteorological information supplied by their Headquarters who would also state the target point which would be:-

> "that point over which it is intended that the access of the Barrage stream should pass at a specified distance from the front of release. For the defence of London the target point will be the TOWER BRIDGE at a distance of approximately 20 miles."

/Fighter Command

(1) He estimated about 25% in a week.

Fighter Command would also issue the orders to put the barrage into effect. As soon as Balloon Command reported the barrage was ready for operations, the procedure would be for Fighter Command and Balloon Command operations staffs to receive a special weather forecast at 10.00 hours daily. On this weather forecast, in consultation with the two staffs, the Air Officer Commanding-in-Chief would decide whether or not to order the barrage to be concentrated and on what sector. If concentration was ordered, a further weather forecast would be obtained at 13.00 hours on which he would decide whether deployment was to proceed. It it was so decided, Balloon Command would select the appropriate front and order deployment. By 18.30 hours, Fighter Command would probably be in a position to assess the nature and direction of enemy attack and to issue orders for the barrage to be launched. Based on the plot of the barrage made at Fighter Command in accordance with the weather reports, instructions would be issued to other commands prohibiting flying in the area likely to be affected.

ibid.
Encl.134A.
1.1.41.

The first launching of the Free Balloon Barrage took place on the night of the 27th December, 1940. In accordance with meteorological conditions, it was decided to deploy from No.3 Balloon Centre at release front No.13 situated on the Hertford/Hatfield road. At 18.55 hours there were some 20 raids plotted on the operations room table at Fighter Command, and the order to launch the barrage was given, the first balloon ascending at 19.30 hours. At 21.30 hours enemy air activity had virtually ceased and orders were issued to make no further releases and the last balloons were launched at 22.10 hours. This delay was caused by unsatisfactory communications. While the barrage was in flight, two radio-sounding balloons (1) were flown, and readings taken disclosed that the balloons were flying in a wind blowing at 46 and secondly 39 miles an hour from 335 degrees at a height of 23,000 to 24,000 feet, a much greater height than had been intended. Reports were received from Observer Corps posts as far apart as Hatfield, Stanmore, Edenbridge, Hever and Beachy Head of explosions and flares in the air and on the ground. There were no reports of contact between free balloons and enemy aircraft. Of 963 balloons inflated with hydrogen, some 305 were found to be unserviceable because of valve failure, pin pricks in the balloons, and balloons bursting when fully inflated. These failures materially reduced the speed of release. Of the balloons launched, some exploded very early in flight, and a considerable number failed to fly satisfactorily so that balloons and wire were retrieved at many places in the London area. Thus, the first test disclosed grave deficiencies in the equipment and in the signals organisation.

ibid.
Encl.147A.
15.1.41.

A second operation took place on the 11th/12th January, 1941, when balloons were launched from the north-west sector. This time the balloons were weighted so that they flew at about 18,000 feet with a fuse setting of two hours, but once again there were failures of equipment as some 542 balloons were found to be unserviceable out of 1,794 inflated. Again parts of the device were discovered scattered over the London area and some as far afield as Somerset. No contacts with enemy aircraft occurred.

AHB/IIH/240/4/140
~~AHB/240/4/140~~
~~WO/8/24405~~
Encl.2B
18.3.41.

The disappointing results of these tests were discussed at a

(1) Radio-sounding balloons were balloons similar to those used in the Free Balloon Barrage to which a radio transmitter had been fitted, capable of sending out signals which could be received at ground level. Signals relating to height were taken by a receiver installed at Fighter Command, and the track followed was measured by 3 ultra-short-wave direction finding stations set up specially for this purpose and in direct telephone communication with the control room at Fighter Command. Position and altitude were plotted on a map in the control room at Fighter Command.

ibid. Encl.150A. 16.1.41. at a conference held at the Air Ministry on the 16th January, and the two main conclusions reached were that the balloon units would have to be improved to be effective and the density of the barrage should be increased by releasing from static balloon sites as well as the existing release points, as it had been calculated that the possibility of bringing down enemy aircraft with the number of balloons released on the 11th January was negligible, amounting indeed to one-third of an enemy aircraft. Meanwhile, the Admiralty was undertaking further trials of Free Balloon Barrage equipment.

ibid. Encl.154A. 21.1.41. These were to take the form of long distance flights in the vicinity of the south coast to determine how many units could be relied upon to reach and maintain their correct height and how many descended below 10,000 feet before destroying themselves. It was also hoped to find out the effects of ballast on height maintained and what improvements could be effected by making changes in the equipment. Other trials, also under the supervision of the Admiralty, were to take place at Cardington to find out how many units were lethal at the correct height and how many destroyed themselves at the end of their flight. Air Chief Marshal Dowding pointed out that the failure to bring down any aircraft in the trials so far undertaken did not necessarily indicate the ineffectiveness of the Free Balloon Barrage, owing to the small number of balloons flown. Alterations and modifications were being made in the existing apparatus. For future policy, he advocated a plan previously proposed by the Air Officer

ibid. Encl.110A. 28/1/41. Commanding, Balloon Command for the release of free balloons from balloon centres all over the country across the routes followed by enemy aircraft.

In the meantime, grave doubts were being expressed as to the advisability of continuing with the use of Free Balloon Barrages. On the 29th January, Professor Lindemann, scientific adviser to the Prime Minister, prepared a minute for the Prime Minister on the operation of the Free Balloon Barrage. He calculated that 10,000 mines with an 18 miles-an-hour wind would be necessary to bring down 6 or 8 machines out of 55, the number which had passed unscathed through the barrage on the night of the 11th January. He considered this was a very extravagant use of mines. Mr. Churchill forwarded the minute to the Chief of the Air Staff (Air Marshal Sir C. Portal) who agreed that the weapon was uneconomical and pointed

ibid. Encl.163A 2.2.41. out that further disadvantage was the time required to put it into action; on the other hand it could be used against enemy aircraft when weather conditions prevented our own aircraft flying. Professor Lindemann was not the only person,

ibid. Encl.168B 4.2.41. by any means, who did not consider the Free Balloon Barrage a good weapon. The Deputy Chief of the Air Staff (Air Vice-Marshal A.T. Harris) in a minute addressed to the Chief of the Air Staff asked for:-

> "this ill-considered, expensive, and almost useless project to be abandoned before we are further embarrassed by the demands which it is making upon our resources in material and manpower."

ibid. Encl.168A 8.2.41. The Deputy Chief of the Air Staff resumed the attack in a note commenting on a paper (1) by the Third Sea Lord on the Free Balloon Barrage. He quoted the figures set out by Professor Lindemann and stated that to fly a barrage of 10,000 units would entail vast quantities of hydrogen and some 5,000 trained men, while weather conditions would only be suitable for operations on very few occasions. In addition, enemy

/aircraft

(1) Night Air Defence (41) 6th February, 1941.

aircraft could be protected easily against the thin cables. The mine unit itself was technically unsatisfactory, and considerable research and development would be required to make it reliable. Air Vice-Marshal Harris was not a man who minced his words:

> "All this effort will bur succeed in deploying an almost worthless form of defence, which, if we decided to use it with any frequency in large enough numbers in sufficient areas, would be as much of an embarrassment to our own bombers and fighters as to the enemy."

He considered that the statement made by the Third Sea Lord that the reduction and alteration of enemy attacks might be due to the respect with which the enemy regarded this form of defence was unsupported by a shred of evidence.

ibid.
Encl.170A
13.3.41.

Further reference was made to the use of the Free Balloon Barrage at the Prime Minister's Meeting on Night Air Defence held on the 10th February, 1941. It was agreed that the operational control should remain with the Air Officer Commanding-in-Chief, Fighter Command, who would use his discretion in regard to releasing the barrage when winds from the north and west might carry balloons into enemy territory. It was also agreed that, in view of the uncertain value of the free balloons as a vehicle for the aerial mine, the Admiralty should consider the diversion of some of the equipment to long aerial mines carried in minelaying aircraft.

A further trial of what was now known as the 'Albino' operation took place in the London area on the 11th March when nearly 1,600 balloons were released from Kidbrooke and from a front between Brentwood and Tilbury.

ibid.
Encl.185A
27.3.41.

Again there was no evidence of any damage being inflicted on enemy aircraft, but a much higher speed of release was attained. The immediate future of 'Albino' was settled at the Prime Minister's meeting on Night Air Defence held on the 24th March when Mr. Churchill decided that:

> "the free balloon barrage should be operated for a further month in the Liverpool area, and that during this period production of free balloon barrage equipment should be maintained at its present level. After a month the matter should be brought before the Committee for a decision whether the free balloon barrage should be further proceeded with."

Thus, despite its critics, the Free Balloon Barrage still had a strong advocate.

The Liverpool Trials.

S.6866 Pt.II
Encl.5B.
29.3.41.

Arrangements were made for the transfer of 'Albino' operations to Liverpool at the end of March, 1941. It was decided, at the instance of the Admiralty, on account of the danger of faulty equipment falling in a densely populated area to postpone large-scale trials involving 10,000 balloons until the 6th May, when improvements would have been made in the unit. Small-scale trials could take place after the 15th April, to ensure that local arrangements were satisfactory and to provide training. Releases would be from the balloon centres at Fazakerley and Warrington and arrangements were again made for obtaining the assistance of the National Physical Laboratory in the experiment. No further trials were, however, held until the Admiralty produced its second edition of what had become an anathema to the Air Staff.

/The Mark

ibid.
Encl.35B.

The Mark II balloons differed from those originally supplied in that the height setting of the balloon no longer depended on ballast bags carried, but a complete new valving and height control system had been introduced. In addition, a barometric self-destructor had been fitted which would destroy the apparatus when the lower end of the cable descended below 10,000 feet. The length of flight was still governed by the burning of a fuse. The equipment could be set for flight between 28,000 and 14,500 feet.

ibid.
Encl.47A.
22.5.41.

A test of the new equipment took place on the 15th May, from Nos.8 and 9 Balloon Centres during which 288 balloons were launched. Communications worked so well that only six minutes elapsed between the order to release being transmitted and the first balloon being launched, but the speed of release was slow as the trained operators from London were not used in order that the Liverpool airmen might gain in experience. A number of premature explosions occurred, but only in one instance was a live unit found on the ground indicating that the barometric self-destruction device had worked well.

ibid.
Encl.58A
3.7.41.

During the ensuing months the 'Albino' unit remained in readiness at Liverpool, but no further trials took place. On the 3rd July, the Air Officer Commanding-in-Chief, Fighter Command, reported to Air Ministry that 'Albino' had been cancelled 35 times owing to the unsuitability of weather conditions and had stood by to operate 24 times. Of these 24, only one was unsuitable for the operation of our own aircraft and on that solitary occasion no enemy aircraft had approached Liverpool. The short periods of darkness during the summer made a proper test impracticable as, if enemy aircraft came at all, they could only remain in the vicinity for about two hours at that season and this would not give time to put the full barrage into action. Accordingly, the Air Officer Commanding-in-Chief, Fighter Command, asked for the trials to be postponed until September. Those who regarded the 'Albino' experiments with disfavour were quick to seize upon the opportunity afforded. An Air Staff note was prepared for submission to the Chiefs of Staff Committee which, after analysing the position, recommended that the large-scale trials at Liverpool should be postponed until September; there should be no further extensions of 'Albino' in this country or overseas (1) until the experiments had been concluded and that the manufacture of equipment should be suspended until the autumn. It was agreed that the 'Albino' trial at Liverpool should be suspended until the matter had been brought before the Night Air Defence Committee.

ibid.
Encl.72A.
31.7.41.

Free Balloon Barrage on Balloon Sites

ibid.
Encl.77A
14.8.41.

While the 'Albino' trials at Liverpool were still suspended the Air Officer Commanding-in-Chief, Fighter Command, suggested a more economical form of experiment. Instead of the trials taking place in one area only, he recommended they should be carried out on sites, in the static barrages, selected by a reconnaissance which had been made by Balloon Command. This method would have several advantages over the Liverpool trials. There would be more opportunity to use the weapon as it would no longer be limited to one area. It would avoid the retention of a special body of men, for 'Albino' operations would become part of the ordinary duties of a balloon crew. No hydrogen need be specially assigned for the purpose because Balloon Command would distribute trailers usually held in hydrogen parks at balloon centres to sites from which the Free Balloon Barrage would be flown. The Admiralty had agreed to

/supply

ibid.
Encl.73A
6.8.41.

(1) About this time the Admiralty suggested that 'Albino' should be used in defence of Singapore.

supply containers for storing the units and structures from which to release them. The proposals advanced by the Air Officer-Commanding-in-Chief, Fighter Command, were approved by the Night Air Defence Committee, and 'Albino' was transferred to the care of the static barrages. The barrages from which 'Albino' was to operate were as follows:-

ibid.
Encl.78A
16.8.41.

London	114 sites
Birmingham	59 "
Bristol, Avonmouth, Filton	31 "
Portsmouth, Southampton	49 "
Plymouth	25 "
Liverpool, Runcorn	58 "
Hull	36 "

ibid.
Encl.82A.

The operational instructions issued by Headquarters, Balloon Command showed that the first idea of covering an objective by an aerial minefield had been abandoned for it was stated that the purpose of the barrage was the interception of the approach of enemy aircraft towards a target. The Free Balloon Barrage was to be regarded as of equal operational importance to the static barrage. Each site was expected to release twenty balloons an hour, over a period not exceeding four hours. Included in a release crew would be two airmen who had had previous experience of 'Albino'. Each crew would use two inflation tents, and each site would have two hydrogen trailers which were to be used for 'Albino' purposes and also to inflate L.Z. balloons. 'Albino' launchings would take place under suitable weather conditions when enemy aircraft were present in sufficient numbers to make interception practicable and when friendly aircraft were not flying. Crews were to prepare for an operation nightly unless a cancellation was received.

S.6866 Pt.III
Encl.1A.
13.10.42.

Once again all was ready for 'Albino' to be tested but nothing happened and for a year there were no operations except for small practice releases conducted under local arrangements. In October, 1942, the Night Air Defence Committee abolished 'Petard' but decided to continue with 'Albino' as no extra men were involved and it fitted into an existing organisation. But Fighter Command was becoming weary of being burdened with a device which would probably never be used and which was so hedged about with restrictions and so dependent on a combination of circumstances for its employment. On the 26th October, 1942, the Air Officer Commanding-in-Chief, Fighter Command, recommended to the Air Ministry that 'Albino' should be abolished. The reasons he put forward were that since its inception in 1940 our night fighters had improved and were now able to go out in all weathers, while our anti-aircraft defences were also much more efficient. Although no special units existed for the operation of 'Albino' a large amount of perishable equipment was involved which now required replacement. Training for 'Albino' occupied much time and this was further complicated by Women's Auxiliary Air Force substitution as the airwomen balloon operators had already more than enough to occupy them on their short course of training without having to learn how to operate 'Albino' in addition to L.Z. balloons.

ibid.
Encl.2A
21.10.42.

/These points

ibid. Encl.9A. 15.11.42.

These points were the main arguments advanced by the Secretary of State for Air (Sir Archibald Sinclair) when, in a paper prepared for consideration by the Night Air Defence Committee, he reviewed the melancholy history of 'Albino' and asked for the scheme to be abolished. No immediate decision was forthcoming, as the Night Air Defence Committee was not meeting for some time, but the Air Officer Commanding-in-Chief, Fighter Command, at the instance of Balloon Command, continued to represent the urgency of the matter stressing the deterioration of the equipment and the training problems arising as more 'Albino' sites were occupied by the Women's Auxiliary Air Force. Finally, the matter was put before the Prime Minister for his decision. At this juncture, its first sponsor and strongest supporter, the Admiralty, put forward a final plea for the retention of 'Albino':-

ibid. Encl.12A 17.11.42.

ibid. Encl.15A 22.11.42.

ibid. Encl.17A. 11.12.42.

> "The First Lord would very much regret abolishing his weapon, which he feels has hardly had a fair trial."

While training difficulties were appreciated, it was thought that women could easily learn to operate Free Balloon Barrage equipment, and, if necessary, 'Albino' could be limited to the ports of Plymouth, Bristol, Southampton and Portsmouth. Under these circumstances the reduced quantity of perishable equipment, which was in any case an Admiralty responsibility, could be easily maintained. In conclusion it was stated:-

> "We think it incorrect to assume that our defences have sufficiently improved by comparison with the enemy's methods of attack, to allow us to neglect the study of fresh weapons; and the First Lord would urge that, since the tax on our manpower is not in this case appreciable the trial and development of 'Albino' should be pursued with persistence. We feel that the danger of renewed air attack on this country cannot be discounted, and we are in agreement with the decision given in Night Air Defence (42nd) 3rd Meeting of 13th October, 1942, to continue 'Albino'."

ibid. Encl.20A 9.12.42.

ibid. Encl.22A 17.12.42.

The conflicting views of the Admiralty and Air Ministry were placed before the Prime Minister who, while agreeing with the conclusions of the Secretary of State for Air, thought the matter ought to come before the Night Air Defence Committee. At a meeting of this committee on the 17th December, 1942, memoranda prepared by the Secretary of State for Air and the First Lord of the Admiralty were discussed. The First Lord pleaded for the retention of 'Albino' on a reduced scale as an alternative to other means of defence, but it was pointed out that 'Albino' made it impossible for our fighters to operate, and that the nights on which fighters could not operate would be most unlikely to be those chosen for large-scale enemy attacks. The Prime Minister said that 'Albino' had been given fair consideration. The time had now come to simplify our night defence measures and to concentrate on those which were most effective. Finally, the meeting agreed that 'Albino' should be abolished. Thus, an expensive and ambitious project came to a belated end.

OPERATION 'PETARD'

AHB/IIH/240/4/148
~~FO/S.27072~~
Encl.1A.

On the 12th December, 1941, the operations officer responsible for 'Albino' matters at Headquarters, Fighter Command (Squadron Leader J.G. Hudson) suggested that a form of the Free Balloon Barrage should be used as a defence against enemy minelaying aircraft. The balloons could be released from Felixstowe, Birchington, and Sheerness to cover the Thames Estuary and from static barrage sites at Hull, Liverpool and Bristol.

/The Air

ibid.
Encl.11A.

The Air Officer Commanding-in-Chief approved the suggestion and instructed Balloon Command to submit a plan for the operation. This was issued on the 29th December, under the code name 'Petard'. The intention was to release balloons over the area known as Barrow Deep, a channel off the Essex coast running approximately from Shoeburyness to Clacton-on-Sea. Enemy aircraft usually approached this area from the east, some time being spent in the area of the triangle formed by Margate, Isle of Grain, and the Naze, before mines were laid. This, therefore, appeared to be the most suitable area for interception by balloons which would be released from land sites on the coast between Margate and Sheppey to the south and from Shoeburyness and the Naze to the north west. Because the release of the balloons was limited by ground wind speed and wind direction, it would be necessary to concentrate the release parties on the most suitable sections of the coast according to the wind direction of the day. Complete mobility was essential. The difficulties of road communication and the extent of the release areas necessiatated the duplication of the release parties north and south of the River Thames. Thus, they could operate from any one of the five release points which had been selected on each side of the river. The scale of release was to be 1,000 balloons an hour up to three hours.

Headquarters, Fighter Command, were to state each day if the operation was required and the front or fronts from which the releases was to be made. The first balloons could be released within 15 minutes after the order was given by Fighter Command, or, if this was preceeded by an order to stand by, in 8 minutes. 500 men would be required for the operation. These could be made available from existing resources. Equipment presented no problems other than a shortage of mines. However, Balloon Command possessed a surplus of 3,000 and the remaining 6,000 required could be found by withdrawing from the London Free Balloon Barrage.

ibid.
Encl.20A.

By the middle of January, 1942, two squadrons had been formed at No.4 Centre and No.1 Centre. A further operational instruction had been issued by Balloon Command now defining the interception area as a triangle covering Foreness Point, the Nore, and the Isle of Grain. Releases were to take place from land sites on the coast between Margate and Sheppey in the south and Shoeburyness and the Naze in the North. The balloons would fly at predetermined heights between 4,500 and 10,000 feet. Height variations were to be in units of 1,000 feet and separate balance weights to cover this range were issued. The height setting would be given at the time of the order 'Petard Standby' or 'Petard Release'.

In February, Headquarters, Fighter Command, issued an operational instruction which stated that 'Petard' balloons were <u>not</u> to be released.

(a) Unless the interception area was completely free of fighter aircraft.

(b) Unless release would not restrict or endanger operations undertaken by Bomber Command.

(c) When the wind speed at 4,500 feet was more than 40 miles an hour.

(d) When the surface wind was over 25 miles an hour.

/The normal

The normal release would be 1,000 balloons an hour, increased to 1,500 if the wind was from the west south west. A full release would last six hours; that is to say the balloons would be in the air for six hours from the time the first balloon was released until the last balloon destroyed itself.

AHB/IID/24/4/13(A)
KBO/S.51463 -Ops.- Encl.89A.

FIRST OPERATION

'Petard' operated for the first time on the night of the 18th March, 1942. The meteorological forecast for the night over the Thames Estuary was:

Wind surface - S. 10/15 m.p.h.
4,500 feet - 210° - 19 m.p.h.
Weather - cloudy 1,000/1,500 feet.
Poor visibility. Similar over Holland.

The order was given for the South Squadron to deploy at Swalecliffe, near Herne Bay, at 16.24 hours, and the squadron was ready to operate at 18.36 hours.

At 19.56 hours the first enemy plot appeared on the operations room table at Headquarters, Fighter Command. At 20.01 hours the release parties were ordered to stand by, enabling one balloon to be inflated ready for release.

Prior to the appearance of the enemy, there was no information from the "Y" service; nor was any information forthcoming when the raid commenced.

The enemy plots increased in number and as they appeared to be heading for the Thames Estuary, Balloon Command were instructed to release at 20.10 hours.

12 aircraft were plotted in this phase; they appeared to adopt new tactics, flying straight in and then out again. The usual signs of the minelayers flying around the Estuary to seek out their targets before dropping their mines were absent.

At 20.52 hours, the enemy left the Estuary and the order to "cease fire" was given. As no further enemy activity seemed likely the squadron was ordered to pack up and return to base.

However, at 21.42 hours, a second enemy raid of about 8 aircraft appeared from the Hook of Holland area, but it was too late to recommence the release. Nevertheless, it was considered that some of the 'Petard' units released against the first aircraft might intercept the second, but this did not, in fact, happen.

The results of the release from a practical point of view were negative. One plot, fading 15 miles north of the release front, raised a few optimistic hopes among the more enthusiastic 'Petard' supporters, while another remained over the Estuary for about one hour after the remainder had gone home. This latter plot "indicated an aircraft circling round the same spot....as if in difficulties, and then turned S.E. for some miles, before it changed course to N.E. and made for home."

405 units were airborne, the last being released at 21,04 hours. They were set to fly at a mean height of 4,500 feet.

/The ground

The ground Controlled Interception station at Willesborough and the Chain Home station at Great Bromley obtained responses on their tubes from the 'Petard' wires and some heights were recorded at 7,000 to 11,000 feet. This was considered due to the fact that owing to the extra weight caused by the rain on the units, and the low ground wind speed, some units fouled local obstructions resulting in the wires breaking and the balloons rising above their pre-determined heights, because of the lesser weight carried.

AHB/IID/34/4/13(8)
~~AIR/8.5463/~~
~~Ops.Part II~~
Encl.5A.
et. seq.

SECOND OPERATION

'Petard' did not operate again until the last night in March. Both squadrons were deployed on this occasion.

The release took place over a period extending from 20.40 to 22.07 hours, during which time a total of 2155 units were released. Of this number, some 70 per cent operated efficiently and appeared to be travelling in the correct direction. Of the remainder, 20 per cent exploded prematurely in the air and 10 per cent came to earth intact. A number of the balloons were also shot down by the army as they passed over the Isle of Sheppey. This, coupled with the fact that several overhead electric cables had been fouled and parts of the island had been plunged into darkness, caused considerable alarm among the local inhabitants who thought an invasion of their island had commenced.

On the 1st April, the 'Petard' units caused further trouble. In attempts to salvage unexploded units two airmen and an Admiralty policeman were killed, two children were injured and subsequently died, and three airmen seriously injured, despite many warnings broadcast in the vicinity that the units should only be touched by Bomb Disposal units.

The effect of this release upon the enemy was nil for the simple reason that the enemy failed to arrive over the Estuary. The release had been ordered, however, for the following reasons:

(a) Intelligence sources indicated that there might be enemy activity in the Estuary area.

(b) The wind conditions were exceptionally favourable, allowing both squadrons to operate at the same time.

(c) Bomber Command had given permission for the operation to take place.

(d) No.11 Group were not operating.

/This was

This was the last occasion on which 'Petard' operated, although the squadrons stood by on a number of occasions.(1) On the 28th October, the operation was cancelled. Like its big brother, 'Albino', 'Petard' had failed to be of any value whatsoever.

'PETARD CHILD'

Before closing the subject of the Free Balloon Barrage, reference must be made to Petard Child.

This consisted of a signals unit which operated in the Hull area, transmitting signals which it was hoped would lead the enemy to the assumption that 'Petard' was operating on certain occasions in the vicinity of the Humber. As far as can be seen the enemy remined in ignorance of the whole affair.

/SECTION 23.

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(1) The operational career of 'Petard' may be summarised as follows:

From 11th February to 28th October, 1942.		No. of Nights.
Enemy minelayers active		
'Petard at readiness.		20
(a) Released:		
Against enemy.....	1	
On chance	1	2
(b) Not Released:		
No enemy activity	116	
Enemy active but under 10 in number.....	2	
Other reasons.....	2	120
Cancellations.		
Weather.....	115	
Administrative reasons,....	1	
Bomber Command objections..	20	136
Total nights		258

SECTION 23

BALLOON BARRAGES - MIDDLE EAST

After the Allied withdrawal from western Europe and on the entry of Italy into the war, the Mediterranean theatre became of vital importance.

It was essential that the lines of supply to our forces in the western Desert, the fleet anchorages at Alexandria and Malta, and the important ports at Haifa, Port Said and Suez remained as free as possible from attack. The possibility of heavy and prolonged air attack against these targets was anticipated as soon as the Luftwaffe reinforced the Regina Aeronautica.

The Ports Defence Committee gave the matter such high priority that it was decided in August 1940 to recommend the establishment and maintenance of a barrage of twenty-four balloons at Alexandria as an urgent requirement, even at the expense of Admiralty requirements at home.

The difficulties of maintaining such a barrage were foreseen from the start, as no facilities existed in the Middle East for providing essential supplies such as balloons and hydrogen. All equipment would have to be shipped from the United Kingdom. Fortunately a few "A" type silicol plants were available from the last war and could be utilised for the supply of hydrogen, but as there was no local supply of silicol or caustic soda, shipping of the necessary chemicals would have to be carried out direct from Canada and the United Kingdom respectively.

Another difficulty visualised was the reaction of Mark VI balloons to semi-tropical weather conditions. No information existed with regard to this subject, so that any data collated by these early balloon units would prove very useful in shaping the future balloon policy abroad.

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Encl.7A.
App."C"
1.10.40.

At a meeting at the Air Ministry on the 1st October, 1940, it was decided to recommend to the Chiefs of Staff Sub-Committee that a barrage of thirty VLA balloons be provided for Alexandria, to proceed during the fourth week of November.

As a result, No.971 Squadron was formed at Cardington and the advance party sailed for Egypt on 21st October, 1940. It arrived at Alexandria on the 25th December, flying its first balloon on the 4th January, 1941.

By the 11th January, the barrage was increased to twenty balloons, all flying over the port and its installations.

Additional Demands Overseas

Meanwhile at home, the Admiralty and Air Ministry, alive to the increasing threat to the Middle East, decided, at a meeting held on the 28th January, 1941, at the Air Ministry to provide additional barrages in that area.

ibid.
Encl.16A.
28.1.41.

The threat to Malta had increased; in addition, it had become necessary to hold Crete and Piraeus as bases for our troops in Greece, and the Luftwaffe was within striking distance of Haifa, Port Said, Suez and the Suez Canal. Apart from these dangers, it was possible that the Fleet would require anchorages other than their permanent bases.

/All shipping

All shipping to the Middle East was now making the long trip via the Cape, Freetown had, therefore, become a vital refuelling station, which would be in danger of attack should the enemy gain bases in French Africa.

Japan, the third signatory to the Tripartite Pact, was becoming restless, and the Sino-Japanese war, although not yet menacing, threatened to involve the British Empire ultimately.

At this conference, the Admiralty representative pressed for a mobile barrage to be despatched to the Mediterranean as soon as possible, while the Directorate of Operations (Overseas) representative said that Malta and Singapore each urgently required a barrage of L.Z. balloons.

It was agreed that the provision of further Mark VI barrages overseas depended upon the hydrogen supply situation and the following order of priority was agreed :-

Crete (10 Balloons) and Malta (30 Balloons), for which squadrons were at the time being formed, would have first priority, followed by -

One Mobile Barrage	50 Balloons
" " "	50 "
Port Said	10 "
Suez	10 "
Haifa	10 "
Singapore	30 "
Freetown	10 "
Penang	10 "

To keep these barrages fully operational and bearing in mind the long supply route to Egypt it was estimated that 2,713 balloons would be required.

The Director of Hydrogen Production estimated that not more than ten VLA balloons could be maintained, under tropical conditions, by one portable "A" Type silicol plant, and that forty-eight portable hydrogen plants were needed to maintain these barrages.

Upon the speed of manufacture of essential equipment depended the number of squadrons that could eventually be sent overseas. At this time only ten portable silicol plants, relics of the first World War, were available, of which four were already in Egypt. The production of Wickham winches also had not yet started, but it was hoped to produce five per week from mid-February.

Formation of Nos.972 and 973 Squadrons

Nos.972 and 973 Squadrons Forms 540.

The formation of Nos.972 and 973 Squadrons at Cardington, each intended to operate 10 balloons, was accelerated and on the 17th February both embarked for Egypt. No.972 Squadron was to provide the barrage for Malta and No.973 Squadron that for Suda Bay.

In Egypt, the Officer Commanding, No.971 Squadron had made a reconnaissance of both Malta and Suda Bay preparatory to his unit operating in those areas, but the project had been dropped in favour of providing a barrage at the southern end of the Suez Canal.

/Although operating

Although operating to capacity at Alexandria and providing a few balloons for merchant ships, No.971 Squadron responded well to the call for additional balloon cover and on the 24th February, 1941, 16 balloons became operational over the Suez Canal at Challouffe.

More Reinforcements Required

~~A46/1D/54/S/S(4)~~
~~KBC/50896/~~
~~ORS.~~
Encl.66A.

The despatch of two squadrons of 10 balloons each, however, did not go far in providing the balloon defences required in the Middle East and led Headquarters, Royal Air Force, Middle East, to signal the Air Ministry requesting that the next squadron to be despatched, should consist of 3 flights, each of 10 balloons.

Meanwhile the prodigious efforts of No.971 Squadron had resulted in the exhaustion of the Middle East stock of balloons. In December 1940 general equipment to maintain the squadron was sent, but owing to the prevalent shortage no balloons were included. The matter would appear to have been forgotten for nearly three months and even when brought to light, no serious view was taken of an object considered vital to our commanders in the Mediterranean. Wing Commander Yuille (War Organisation 3) in a minute to his Deputy Director stated:-

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Encl.17A.
9.3.41.

> "It was not until a day or two ago that we accidentally discovered this.
> The reason no balloons have been sent as reinforcements is the usual one - the supply position - which in effect means that other users have been given priority. I suggest that the provisioning branch concerned knew very well that No.971 Squadron was in danger of becoming non-operative.
> It may be fortunate that what would seem to be a fundamental weakness in the system, should have come to light over balloons, which are relatively unimportant."

It can be stated that the Naval Commander-in-Chief Mediterranean held a totally different opinion of the importance of the safety of his fleet anchorages and port installations at Alexandria. He was far from satisfied, and in a signal to the Admiralty, he pointed out that on the arrival of Nos.972 and 973 Squadrons, there would be only 50 balloons to cover 80 miles of the Suez Canal, Alexandria, Malta, the main Libyan supply base at Tobruk, and the Greek supply base at Piraeus, apart from Haifa, Suda Bay and any advance bases that might be needed in future. He suggested that a Middle East pool of 500 balloons together with the necessary personnel, be set up to meet the expanding requirements.

Ibid.
Encl.18A.
12.3.41.

KBC/50896
ORS.
Encl.14C.
15.2.41.

The shortage of equipment at home, however, prevented any immediate improvement in the Middle East supply position but Headquarters, Balloon Command at least showed that the difficulties were fully appreciated and made suggestions designed to alleviate the shortage overseas. One such was that a number of airmen should be trained to manufacture Mark VI balloons. These balloons were made in 30 man-hours at the manufacturers' works and it was considered that 50 man-hours was a fair estimate if airmen and native workers were employed overseas. It would of course be necessary to train airmen in the manufacturers' workshops at home before sending them overseas but no difficulty was anticipated in that connection.

/It is

It is not clear why this suggestion was abandoned because later a unit, consisting mainly of a large balloon repair section (1), was sent to the Middle East; and it would surely have been an easy matter to have included, in its preparatory training curriculum, a short course on balloon manufacture.

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Encl.22A.
21.3.41.

Far from increasing the strength of the barrages in the Middle East, the opposite was seriously contemplated, but in March 1941 the Director of Overseas Operations in a note for submission to the Chiefs of Staff sub-Committee, vigorously opposed any reductions,

> "I do not think", he said, "that we should contemplate the serious reduction in the provisioning programme for Mark VI balloons in the Middle East. It does not follow that because we intend to take the Dodecanese and deny advance bases in Libya to the Germans, that this is an accomplished fact, and we do not want to start providing ground defences after the time has arrived when they are urgently required."

How far this note was successful in bringing the wishful thinkers back to earth is, of course, not known, but as the Dodecanese Islands remained in enemy hands until the end of the war, it would appear to have been most timely.

Renewed Demand for L.Z. Barrages

By far the heaviest commitment was a barrage to cover the Suez Canal which at this time was only partly covered with 10 balloons at Challuffe. It was originally intended to raise this barrage to 300 balloons and any suggestion that this figure should be reduced below 250 was strongly opposed by the Director of Overseas Operations, who stated:-

> "Adequate balloons in the canal area are to my mind essential. The canal is the main artery of our whole military structure in the Middle East and we have already seen how our military plans have been prejudiced by successful mine-laying."

ibid.
Encl.27A.
March 41.

About this time a new factor in enemy activity became apparent - the ability of enemy pilots to lay mines successfully from an altitude in excess of that reached by VLA balloons.

In his note on overseas barrages to the Chiefs of Staff sub-Committee, the Chief of the Air Staff (Air Chief Marshal Sir Charles Portal) requesting additional equipment said:-

> "Certain of the sites, such as the Suez Canal, are likely to be subjected to determined efforts by the enemy to lay mines through the low barrage and although few mines are likely to be laid accurately from heights above the low balloons, it is considered that a few high balloons should be provided as a deterrent. Approval is therefore requested for:-
>
> (a) the provision of 465 Mark VI balloons and 30 L.Z. balloons to be organised in barrages;
>
> (b) provision of 20 L.Z. balloons to mix with the VLAs in certain positions."

/The Committee

(1) Balloon Repair Section, No.260 Wing.

The Committee approved these recommendations and sanctioned the immediate provision of balloons to raise the barrage in the Middle East to 120. No.974 Squadron was formed at Cardington to fly 45 Mark VI balloons in 3 flights. In addition reinforcements were sent to Nos.972 and 973 Squadrons to increase the strength of their existing barrages. These squadrons would in future fly 15 balloons each and No.971 Squadron would fly 45 balloons. The suggested barrage of L.Z. balloons did not materialise and at no time did they make an appearance in the Middle East.

Equipment Policy

ibid. Encl.29A. 11.4.41.

To prevent the barrages becoming non-operational due to lack of equipment it was decided that in addition to the three months pack-up of spares accompanying each unit, a further supply equal to 300% of the initial equipment would be sent one month after the unit sailed. Any subsequent requirement would be demanded by the Royal Air Force, Middle East through the usual channels.

Further Expansion of Balloon Barrages

The year 1941 saw a further deterioration of our postion in the Middle East and on the 2nd June 1941 the Director of Overseas Operations, in a minute to the Deputy Chief of the Air Staff, set out his proposals for increased barrages in that theatre. They were:-

Alexandria	- 45 balloons
Suez Canal	- 250 balloons
Malta, Haifa, Shatt-el-Arab, Freetown	- 150 balloons

Of these, 120 were now in Egypt and of the remainder it was suggested that every effort should be made to send one squadron out each month. The proposals would require some 6,000 personnel of whom only 1,500 were at that time in the Middle East. So urgent had the position become that it appeared very unlikely that the airmen would be given the special training required for Mark VI balloons. Deputy Chief of Air Staff agreed to the proposals, which were then passed to the Director of War Organisation for action.

ibid. Encl.48A. 17.6.41.

The Director of War Organisation considered, that, with four squadrons already operating in Egypt and an additional seven squadrons authorised, a headquarters should be set up to control and administer all balloon units within the Middle East Command. As a result, Headquarters, No.260 Balloon Wing was formed at Cardington in July, 1941, together with the first of the additional squadrons (No.975 Squadron) which was to consist of three flights, each of 15 balloons. Six similar squadrons would follow at monthly intervals.

The Headquarters staff of No.260 Wing consisted of experienced technical balloon officers and was expected to provide valuable data on ballooning under sub-tropical conditions. Group Captain A.S. Jackson was posted to command. Both Wing Headquarters and No.975 Squadron embarked for the Middle East in August, reaching Egypt on the 3rd October, 1941.

/Reorganisation

Reorganisation of Barrages

With the arrival of the new units the balloon defences were redistributed as follows:-

971 Squadron remained at Alexandria and Aboukir

972 Squadron was transferred from Suez Canal zone to Haifa

973 Squadron was transferred from Port Said to Kasfareet and Fanara.

974 Squadron remained at the southern end of the Suez Canal between Genieffe and Port Tewfic. It also operated flights of 15 balloons each at the Oil Refinery Suez, and at Tewfic Docks.

975 Squadron took over Port Said and part of the northern end of the Suez Canal above El Kantara.

This left the Serapeum section of the canal and the long northern section between El Kantara and Lake Timsah to be covered by subsequent units.

On the 2nd December 1941, No.976 squadron disembarked at Suez, and, on the 27th December, took over from No.973 Squadron at Kasfareet and Fanara. It later extended the barrage to cover the Serapeum section and took over that part of No.974 Squadron's area between Genieffe and Challouffee. No.973 Squadron moved to El Kantara on being displaced by No.976 Squadron and shortly after the arrival of No.977 Squadron was again transferred to Beirut (Syria). With the arrival of No.977 Squadron on the 1st February 1942 and its subsequent deployment, all sections of the canal between El Kantara and Lake Trinsah, for which balloon protection had been requested, were now covered.

In January 1941 Air Vice-Marshal Evill (S.A.S.O. Headquarters Fighter Command) carried out a survey of the balloon defences in the Middle East and recommended that the barrages be strengthened by raising the number of balloons employed to 510. The Air Ministry agreed to his proposals, the additional balloons to be operated under local arrangement.

Initial Difficulties

Compiled from Middle East Balloon Units. Forms 540.

With the establishment of the Wing Headquarters, all squadrons moved into their allotted areas with a minimum of dislocation; preliminary arrangements for their accommodation and provisioning having been made in advance.

The weather presented some problems. Meteorological forecasts were most unreliable and sudden unpredicted squalls frequently resulted in the loss of large numbers of balloons. Heat was another problem, and several experiments were attempted to counteract its effect upon balloons, even to flying at 100 feet instead of bedding, and covering with "quilts" made from the top half of unserviceable balloons. These experiments, however, had only a small measure of success, and it was not until light hangars, constructed of timber and rush, were tried that the position became really satisfactory. The porosity rate was enormous and at one time the average life of a balloon was only seven days.

No compressed gas was available for inflations and topping-up, all balloons being inflated at flight headquarters and "walked" to sites. It was not possible to bring balloons to flight headquarters each day for toppin-up, so small "nurse" balloons of about 100 to 150 cu.ft. capacity were made and delivered daily to sites. These were connected to the Mark VI gas inlet and the gas transferred by rolling up the "baby balloon", but the method was not satisfactory. The small balloons quickly became porous and caused low purity gas to be frequently used, but for want of a better system, this procedure was continued until compressed gas was supplied from No.260 Wing's hydrogen plant at Ismailia.

A number of bedded balloons caught fire during the hot seasons and on each occasion friction caused through movement in a light breeze appears to have been the probable cause. In one case of fire, a balloon was swept off the bed, scraped the ground and exploded.

It may be that gas purity was low in each of these cases, but, in October 1941 two "nurse" balloons of recently made gas caught fire while inflations were taking place. The balloon bed in this case was of rough concrete covered with ground sheets, and as the accident occured while the second inflation was being made, a test was made of the gas in the previously inflated balloon. As this showed a normal purity, it was considered that friction caused by the movement of the "nurse" balloon on its rough bed resulted in the hydrogen becoming ignited.

Provision of Additional Balloons

Although each Middle East squadron eventually had an initial establishment figure of 45 Mark VI balloons, many more were in fact flown.

Balloons for shipping in the Red Sea and Mediterraneam were supplied by Nos.971,974 and 975 Squadrons. Nos.972 and 973 Squadrons also supplied "Defensively Equipped Merchant Ships" to a lesser extent. The static barrage flown at Alexandria and Aboukir by No.971 Squadron consisted at one period of nearly 60 balloons, as did that of No.974 Squadron which, in addition to providing flights of 15 balloons at Suez, Tewfik and on the Suez Canal also flew balloons at Abu Zenima, Ras Gharib and Ataka, and operated the northern end of the Aden - Suez shuttle service.

To No.975 Squadron goes the honour of flying the highest number of balloons at one time. In November 1942 after absorbing one flight of No.977 Squadron, 102 balloons were flown over the Suez Canal and Port Said; in addition 37 balloons were supplied to D.E.M.S. for the Mediterranean shuttle service.

A mobile balloon flight under Headquarters No.260 Wing provided balloon cover at various aerodromes in the Canal area, and on the 3rd May, 1942 an additional flight was formed to operate balloons from trains on the Western Desert Military Railway.

The Effect in the Middle East of Japan's Entry into the War

The entry of Japan into the war necessitated some delay in providing the required squadrons for the Middle East, Nos.978, 979 and 980 Squadrons previously earmarked for Iraq and Persia being diverted to India.(1) Headquarters, Royal Air Force, /Middle East.

(1) See 447.

Middle East also provided a balloon flight for Rangoon but before it arrived at its destination the city had fallen to the Japanese.

The rapid advance of the Japanese resulted in No.980 Squadron being re-diverted to Basrah where it provided balloon cover for the Anglo-American Oil Company's refinery at Abadan.

Palestinian Personnel

To help alleviate the acute manning position in the Middle East, Palestinians, both Jews and Arabs, were enlisted locally in the Royal Air Force Balloon squadrons. The standard of intelligence of the Jewish portion was high and many became adept at balloon handling.

Difficulties encountered between British and Palestinian personnel were mainly due to outlook and difference of character. Entries from the Operations Record Book of No.975 Squadron illustrate the general feeling.

In February, 1941 the squadron were ordered to exchange 40 Balloon Operators for 40 Palestinians from No.972 Squadron operating at Haifa. This move was made to conform with the Middle East policy that Palestinians must not be posted to units in Palestine.

Although regarding the exchange as a serious blow to the efficiency of his squadron, the Commanding Officer at the end of February writes:-

> "Few complaints have as yet been made regarding the conduct and efficiency of the Palestinians. Many do not speak English or speak it badly but it is believed, with handling, these men will be useful balloon operators".

The entry at the end of April reads:-

> "This squadron has suffered considerable losses in personnel by detachment, posting and exchange for Palestinians."

At the end of August 1941 the whole position was summed up in the following words:-

> "The Palestinian problem is becoming very difficult. The difference in race and character between the British and Palestinian personnel is becoming most marked and despite strong action, an anti-Semitic feeling appears to be rising. The Palestinians on the whole are good workers but the bad proportion are very bad. One of the chief troubles is absence without leave. This occurs among Palestinian personnel quite out of proportion compared with British airmen.
> The conclusions are that, despite the lack of manpower, the squadron would be happier without them."

Whatever the official view, balloon squadrons as a whole did not look upon Palestinians favourably.

Aden - Suez Shuttle Service

In October, 1941, the Admiralty in conjunction with the Air Ministry made plans to operate a full-scale balloon shuttle service on ships in transit between Aden and Suez.

/It was

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Encl.4A.
26.10.41.

It was intended to fly balloons from 30 ships proceeding in each direction weekly. Two balloons with 12 cylinders of hydrogen would be placed aboard northbound ships at Aden. One balloon would be inflated when the ship entered the danger area, i.e. two days from Suez, and would be maintained with the balance of the gas during the remainder of the northbound voyage and for the period of the ship's stay at Suez. Before departure on the southbound voyage, ships would receive a newly inflated balloon in exchange for that flying. This would be maintained until the ship was two days south of Suez when it would be deflated. On arrival at Aden both deflated balloons and the hydrogen cylinders would be handed over.

The scheme as envisaged would require 2,520 hydrogen cylinders, 1 silicol plant and 2 compressors to be sent to Aden and 1 silicol plant at Port Tewfic (Suez). Some assistance in recharging cylinders would be possible after June 1942 from Ismailia, by which date the hydrogen compressors, yet to be installed, would be ready.

ibid. Encl.36A, 22.1.42.

Personnel to maintain the service would be posted from the United Kingdom and would consist of 1 officer, 5 N.C.Os., 20 airmen and 7 civilian labourers at Aden; and 1 officer 3 N.C.Os. and 23 airmen at Suez. The estimated initial establishment of balloons was 400 with an initial reserve of 100 per cent. The monthly wastage was estimated at 400 balloons. Naval personnel would man the balloons aboard ships.

Full operations would not be possible until the gas compressors were installed at Aden, - it was hoped in March 1942, - but it was necessary to provide immediate cover for important convoys. To this end, No.974 Squadron provided a modified service in December 1941, supplying ten balloons. This figure was raised to 66 in January 1942 and to 83 in February. Royal Air Force personnel was provided to man the balloons aboard ships until March 1942 when this duty was undertaken by D.E.M.S. At the same time No.1436 Flight took over control at Aden, leaving the section at Suez under the control of No.974 Squadron.

No.974 Sqdn. Form 540.

The supply of compressed hydrogen to ships was the most difficult part of the operation. No.974 Squadron had in October, 1941 prevailed upon the Anglo-Egyptain Oil Company to manufacture a "B" type silicol plant to the specification outlined in the Official Hydrogen Manual. This was installed later in the month and was in general use from November. It was capable of a continuous output of 10,000 cubic feet per hour. No hydrogen compressors however were available, but, as a result of much searching a three-stage "Messer," oxygen compressor was rescued from the scrap-heap, overhauled, modified and put to work. Its output was only 400 cubic feet of hydrogen compressed to 120 atmospheres per hour but it did yeoman service and was chiefly instrumental in providing the modified service.

That No. 1436 Flight did not at any time reach the target set was entirely due to lack of compressed hydrogen. The compressors at Aden did not become operative until October, 1942, by which time the danger to shipping in the Red Sea and the Gulf of Suez had practically passed.

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In December, 1942 No.1436 Flight was reduced to a "cadre" and ceased operations.

/Protection

Protection of Trains - Desert Railway

In April, 1942, as a result of a meeting between the Air Officer Commanding, Royal Air Force, in Egypt, and the General Officer Commanding, (Lieut. General R.G.W. Stone) British Troops, Egypt, a conference was held at Air Headquarters, Egypt, to discuss the possibility of flying balloons from trains on the Desert Railway between Daba and the Railhead. It was stated that owing to difficulties due to mounting, Bofors guns could not be used and the use of balloons had been suggested by the Air Officer Commanding. Twenty trains used the line daily, at a speed of 30 m.p.h. between Daba and Semilla and 12 m.p.h. between Semilla and the Railhead.

269W/1006/3 Air Encl.15A. 16/4/41

General Headquarters suggested that the army would supply two sets of quadruple Browning guns for each train but it was pointed out that personnel to man them would have to be drawn from Bofors gun crews employed in guarding landing grounds.

A trial run was decided upon with two balloons flying at 1,000 ft. from a converted box-wagon situated directly behind the water tanker of the railway engine. All overhead obstruction such as telegraph wires would be removed. The balloon crew would man one set of guns throughout the run, the Army providing personnel to man the other. On arrival at the Railhead, balloons would be raised to 2,000 ft. to form a small barrage during unloading. If the trial run was successful a balloon flight would be established with its Headquarters at Amriya.

Personnel with machine-gun experience were withdrawn from all balloon squadrons, formed into a new flight based at Misheifa and attached to No.971 Squadron.

Encl.54A 20.5.42.

At 1315 hours on 17th May, 1942, the first balloon protected train left Misheifa for Capuzzo. The Officer Commanding No.971 Squadron accompanied the train and reported on the run as follows:-

> "There was a fresh breeze blowing and the estimated surface wind was 20/25 miles per hour across the railway line from North to South. The balloon flew very steadily, the cable angle varied from 60° to 75° and the tension was strong. Owing to the cross wind I consider the amount of protection given to the train was 75%. At milestone 155, which is a few miles east of Capuzzo, two overhead telephone wires were observed; it was too late to inform the engine driver and it would have been impossible to pull the train up in time as, according to the railway company, it had a load of about 1,000 tons. Owing to the excessive tension put on to the balloon cable by these lines, the inertia link fired causing the balloon to break away. But for this unfortunate incident, the whole flight would have been a success."

Within a few days a new section of the line was opened and trains were able to reach Gambut. This threw a heavier load on the Railway Flight, resulting in a request for a 100% increase in personnel. To provide for this increase the Royal Navy agreed to a temporary reduction of 6 balloons at Beirut, which released 3 N.C.Os and 24 balloon operators.

ibid. Encl.64A. 10.6.42.

June, 1942 saw the rapid advance of the Afrika Korps to El Alamein, and further operations by the Flight were not possible. The excellent spirit of the men who had volunteered for duty with the Flight came to the fore during the arduous retreat. The Train Flight evacuated in four stages; from Capuzzo to Misheifa, Misheifa to Semilla, Semilla to Daba, and Daba to Amriya. Balloons flew on all trains until the last

ibid. Encl.100B. 12.7.42.

/train was

train was out of each position and as each new Headquarters was set up, a barrage was formed. Several train crews were supplied and during heavy, sustained attacks, the balloon operators-cum-machine gunners remined at their posts when all other personnel were ordered to disperse. The Flight retired to Amriya without casualties and with all equipment intact. The Officer Commanding "T" Flight and seven airmen were mentioned in despatches as a result of their actions during the withdrawal.

Although "T" Flight personnel continued to provide machine-gun protection against enemy air attack, few balloons were flown on trains after the withdrawal to Amriya. During the subsequent advance from El Alamein, our fighter strength was such that balloon defence was not needed. Nevertheless, the experiment proved the possibility of providing trains with a large measure of protection against low-flying attack.

Balloon Barrages - Iraq and Persia

Of the Balloon Wing originally destined for Paiforce, now diverted to India, No.980 Squadron finally received orders to proceed to Abadan to fly a balloon barrage over the Anglo-
Forms 540. Iranian Oil Company's oilfields.

As four squadrons would eventually be deployed throughout Iraq and Persia it was decided to form a new wing headquarters. To this end Headquarters, No.275 Balloon Wing was formed at Chessington on the 23rd April, 1942. A nucleus of specialist officers and airmen, with tropical ballooning experience, was posted from units under No.260 Wing to prepare for the arrival of the new squadrons.

On the 28th May, 1942 No.980 Squadron disembarked at Khosrowabad and was deployed at Abadan and Bahrein Island, where the personnel commenced preparation of balloon sites.

Mid-July saw the arrival of the main party of Headquarters 275 Wing together with No.982 Squadron, and on the 8th August, 1942, it was decided to deploy this squadron at Bandar, Shapur, Ahwaz, Kut Abdullah and Dorquaine. At the same time No.981 Squadron, recently arrived in Egypt and now en route for Iraq, was allotted to Basrah and Shaibah.

No.983 Squadron, the last of the squadrons forming No.275 Wing, arrived on the 11th November and was deployed at Bandar Gulf, relieving a flight of No.982 Squadron at Kut Abdullah.

Shortage of equipment delayed operations considerably; indeed it was only by drawing from the Levant that enough equipment was available to operate one squadron. No.980 Squadron was eventually equipped and became operational on the 29th August, flying six balloons. By the end of September, eighteen balloons were deployed but adverse weather conditions prevented flying on eleven nights during the month. The barrage was increased to thirty-seven balloons in November but weather conditions - mainly high winds - again made continuous night operations impossible. No other barrages were operational.

In mid-November it was decided to operate twenty-two balloons at Teheran. No.982 Squadron was ordered to deploy and on the 16th January, 1942 the barrage became operational, flying to a ruling operational height of 1,700 feet. This was, however, the only occasion upon which the barrage flew, orders to deflate being received on the 23rd January.

/On the 16th

On the 16th December, 1942, No.981 Squadron commenced deployment of twelve balloons at Basrah and nine balloons at Shaibah. Although the first balloon flew for two hours on the 29th December, 1942, it was not until the 8th January, 1943 that the barrage became fully operational. Here again the operational life of the squadron was short, orders to deflate and pack up being given on the 17th February, 1943. During its extremely short life the barrage was flown on only nineteen occasions.

The balloon defences of Iraq and Persia were re-organized in March, 1943 and resulted in the withdrawal of Headquarters, 275 Wing and three squadrons. No.980 Squadron remained at Abadan to continue the defence of the oil refinery, but even this arrangement was short-lived; on the 21st April, 1943, deflation was ordered and the squadron proceeded to Egypt, where it took over the defences of the northern Suez Canal and Port Said.

No enemy aircraft were encountered during the period of deployment in Iraq and Persia which covered some ten months; this was perhaps fortunate as our balloon defences were never in a position to counter enemy air attack effectively. The result of the venture does not appear to have justified the cost.

Re-organization of Balloon Barrages in Egypt.

The Balloon Barrages in Egypt and the Levant continued to fly, as originally deployed, without encountering serious enemy air activity until the progress of the Eighth Army made advanced supply bases a vital necessity. No.977 Squadron was then withdrawn from the canal zone in November, 1942, for duty at Derna, Tobruk and Benghazi. A flight of sixteen balloons quickly became operational at Tobruk, followed by a flight of six balloons at Derna. It was not until the 11th December that the squadron became operational at Benghazi, flying five balloons. All flights suffered heavy balloon casualties due to intense anti-aircraft gunfire, the initial barrage at Benghazi being completely destroyed after five days.

Form 540.

Supply Difficulties

Great difficulty was experienced in maintaining gas supplies during the early stages of deployment, the hydrogen being manufactured at Ismailia and hauled several hundred miles over poor roads. The first consignment of hydrogen intended to maintain the barrage was despatched from Alexandria by sea. It reached Benghazi on the 19th December, but the ship was unable to dock on arrival and was damaged and partly sunk in the harbour during an air raid that developed that night. The ship, luckily, was not a total wreck and some hydrogen was off-loaded on the 22nd December; by Christmas Day a barrage of fifteen balloons was in operation.

The barrage at Derna was discontinued from the 29th December, thereby easing the strain of supplying Tobruk and Benghazi; nevertheless the terrific anti-aircraft barrage which met enemy aircraft continued to take a heavy toll of balloons, and as shortage of water prevented the squadron's portable silicol plants being used, the hydrogen supply position remained acute. A large number of balloons were also lost through high winds, which had not previously been forecast by the Meteorological Section.

/Despite

Despite these difficulties, an increase of the Tobruk barrage to forty-five balloons was ordered. This was a tremendous task and meant in effect that one flight was required to operate the intended establishment of a complete squadron; however, it was accomplished.

Balloon Barrage at Tripoli

The further rapid advance of the Eighth Army resulted in the supply posts at Tobruk and Benghazi becoming of secondary importance to Tripoli. To cover this port No.976 Squadron, which had been reduced to a 'number only' basis, was quickly reformed in January 1943 and on the 2nd February, following a heavy early morning raid, flew balloons from ships anchored just outside the harbour, which was at that time effectively sealed by enemy blockships.

Another heavy air raid developed at 0730 hours on the following morning. Of this raid the Squadron Operational Diary states:-

> "As was expected, enemy bombers attacked ships lying in the anchorage and it was thought that upon sighting the balloons the aircraft turned sharply to port and the bombs missed the ships by 50 yards."

As with No.977 Squadron the supply of hydrogen handicapped balloon operations. However, No.976 Squadron was able to get better results from its portable silicol plants and despite heavy anti-aircraft gunfire casualties, the barrage was on the whole effectively maintained.

On the 9th April, 1943, a small party left Tripoli for Sfax to fly ten balloons over the anchorage there. This barrage remained operational for one month only and was deflated on the 9th June, due to lack of hydrogen.

A barrage of twenty-five balloons was maintained over Tripoli during May, although very little enemy air activity was now apparent, but on the 18th June the barrage was reduced to fourteen balloons to allow a flight to proceed to Pantellaria. With the deployments at Sfax and Pantellaria, the squadron virtually passed from Middle East Command to that of British North African Forces.

The Middle East Balloon Barrages were now deployed as follows:-

No.971 Squadron	-	Alexandria
No.972 Squadron	-	Haifa
No.973 Squadron	-	Beirut
No.974 Squadron (1)	-	Southern Suez Canal - Port Tewfic, Suez Oil Refinery and Gulk of Suez
No.975 Squadron (1)	-	Northern Suez Canal - Port Said
No.976 Squadron	-	Tripoli, Sfax, Pantellaria
No.977 Squadron	-	Benghazi and Tobruk

Of the remaining squadrons No.980 was in transit from Abadan to Egypt; Nos.981 and 982 Squadrons, together with Headquarters 275 Wing, were in transit to North West Africa, while No.983 Squadron had been reformed and was operating in Malta.

Reduction of Barrages

With the campaign in North Africa rapidly drawing to a close, the invasion of Sicily was envisaged. In April 1943,

/it was

(1) Each of 4 flights.

SASO/CO/74
Encl.1A.
13.4.43.

it was decided to use Mark VI balloons to protect the assault beaches and ports, bearing in mind that it would also be necessary to keep supply bases in North West Africa well protected. Five and a half balloon squadrons was the estimated strength that would be required and Mediterranean Air Command requested that Middle East Command review balloon requirements with a view to releasing sufficient personnel and equipment.

At this time Nos.981 and 982 Squadrons were en route to North West Africa and it was intended that they would be used as part of the commitment, leaving three and a half squadrons to be provided from the Delta area and the Levant. The provision of these would considerably thin out the existing barrages and only after much discussion was it decided to reorganize as follows:-

Squadron	Location	No.of Balloons withdrawn	Replacements if any
No.972	Haifa	16 (one flight)	-
No.973	Beirut	36 (two flights)	-
No.974	Kasfareet	7	
	Ras Gharab	6 (Half Squadron)	-
	Fanara	4	
No.975	North Suez Canal	74 (One Squadron)	By No.980 Squadron ex Abadan
No.977	Benghazi	26	
	Tobruk	40 (One Squadron)	-

Nos.975 and 977 Squadrons were to move complete with squadron headquarters, and No.973 Squadron was to take over the thirty balloons remaining at Haifa, thereby releasing that headquarters to control the third squadron.

Port and Beach Detachments

Before leaving the Middle East, two Port Detachments and four Beach Detachments were formed from the squadrons thrown up. Each was fully equipped and consisted of:-

(a) Port Detachment - Glutton (Augusta)
1 flight of 20 balloons
Personnel - 2 officers, 5 N.C.Os. and 36 airmen.

(b) Port Detachment - Ladbroke (Syracuse)
1 flight of 15 balloons
Personnel - 2 officers, 4 N.C.Os. and 24 airmen.

(c) Beach Detachments each of 12 balloons
Personnel - 1 officer, 7 N.C.Os. and 12 airmen.

Form 540.

No.975 Squadron was eventually relieved by No.980 Squadron on the 28th June 1943 and the latter with the reduced No.974 Squadron, continued the Suez Canal barrage until January 1944 when both squadrons returned to the United Kingdom.

Infiltration of R.E.A.F. Personnel

As the war moved once again to Europe the manpower position in the Middle East was again reviewed. The maintenance of supply bases for our troops in Italy and the security of our lines of communication to the Far East, necessitated retaining a large force in Egypt. For obvious reasons, the substitution of W.A.A.F. personnel could not proceed beyond the town-based units and the larger permanent Air Force stations, certainly not to isolated balloon sites. If the balloon barrages in the

/Delta area

Delta area were to continue, it was decided that they must be operated to a large extent by Egyptians. Egypt was at that time neutral but as balloons were a form of passive defence her neutrality would not be involved.

The scheme generally was to train certain officers and airmen of the Royal Egyptian Air Force in balloon handling, and first stage balloon repairs. As each flight was trained it would be handed over to the Royal Air Force balloon squadron responsible for the defence of the area in which it would operate. Major repairs would be carried out at the central repair unit.(1)

Training Difficulties

DESTROYED. S.59187 Encl.2A.

Initial training difficulties were foreseen, as in addition to language differences a large number of the trainees would be illiterate. In an effort to overcome this a reversal of the usual training policy was adopted. Practical demonstrations were carried out by an expert British crew, accompanied by a running commentary by a British N.C.O. which was translated into Arabic by an Egyptian interpreter. Frequent tests of the rate of absorption of knowledge were made by putting simple but searching questions to individuals. Those individuals considered "bright" were entrusted with simple operations under careful supervision and earmarked as possible instructors and N.C.Os.

Form 540

The trainees for the most part were very keen and soon proved capable of handling balloons under the favourable conditions prevailing. They were gradually absorbed into the barrage as complete flights under their own officers and N.C.Os. until, in January 1944, No.974 and No.980 Squadrons were relieved and returned to the United Kingdom. At the same time No.971 Squadron was considerably reduced in strength and continued on a one-flight basis with twenty-four balloons.

The necessity for maintaining a barrage in Tripoli was also reviewed and resulted in the withdrawal of No.976 Squadron, which also returned to the United Kingdom.

The balloon barrages were now deployed as follows:-

206G/S.2946 Encl.30A 1.2.44.

(i) Headquarters, 260 Wing, Ismailia, responsible for:-

(a) Technical and administrative control of balloon squadrons and ancillary units in Egypt.

(b) Liaison with balloon squadrons operated by the Royal Egyptian Air Force.

(c) Equipment accounting for Royal Air Force Balloon Units in Egypt.

(d) Equipment accounting control of all equipment loaned to the Royal Egyptian Air Force Balloon Squadrons.

(ii) No.971 Squadron, Alexandria, on a one-flight basis, operating 24 I.E. balloons.

(iii) No.973 Squadron operating 60 balloons.
H.Q. and 3 Flights at Haifa
1 Flight at Beirut
1 Flight at Tripoli (Syria). /(iv)

(1) Balloon and Oxygen Centre formed in January 1943 for the supply and repair of balloons and for the supply of compressed gas.

(iv) No.2 Shore Servicing Unit, Benghazi } Responsible for supply and maintenance of balloons for D.E.M.S.

(v) No.3 Shore Servicing Unit, Port Said }

In addition a small reserve detachment was formed for possible forthcoming operations.

The Suez Canal barrage was known as -

No.1 R.E.A.F. Balloon Squadron (North Suez Canal)

No.2 R.E.A.F. Balloon Squadron (South Suez Canal)

Form 540

Final Elimination of Middle East Barrages

On the 26th May 1944, the reduced No.971 Squadron handed over to the Royal Egyptian Air Force and was reduced to "number only" basis on the 23rd June. No.2 Shore Servicing Unit was discontinued at Benghazi and reformed at Alexandria. The only remaining Royal Air Force barrage was No.973 Squadron in the Levant, which continued to operate until October 1944, when it too was reduced to a "number only" basis.

The Royal Egyptian Air Force balloon Squadrons continued until November 1944, when it was decided that all possible danger to the port installations at Alexandria and to the Suez Canal had passed. Headquarters, 260 Wing was ordered to withdraw all equipment and wind up the barrages, denuding the Delta of its balloons.

Of the Royal Egyptian Air Force units, it cannot be said that their operation of the barrage was up to the standard of British balloon operators. How they would have reacted under sustained enemy action it is not possible to assess, as none was encountered. That the steadiness shown by the British operators under blitz conditions would be displayed by their Egyptian counterparts, could hardly be expected, but the substitution did fill a need when the manpower shortage was most acute.

Form 540

Headquarters, No.260 Balloon Wing

Formed at Cardington under Air Ministry authority on the 15th July 1941, to control and administer eleven balloon squadrons in the Middle East and West Africa, Headquarters, No.260 Balloon Wing arrived in Egypt on the 4th October 1941, and later made its Headquarters at Royal Air Force Station, Ismailia.

It was not well received and a few days after arrival the Wing Commander, Group Captain A.S. Jackson) was summoned to a conference at Headquarters, Royal Air Force, Middle East, to explain its policy and justify its establishment. At this meeting he said:

> "....the Wing is intended to control eleven Squadrons in the Middle East and West Africa. It is a 'bastard' formation, something between a Balloon Centre and a Balloon Group and is no way analogous to a Flying operational Wing."

It was an untried formation and he recommended that it be allowed to function as laid down by the Air Ministry.

/In reply

In reply to the criticism that certain appointments carried too many senior ranks, Gp. Capt. Jackson pointed out that when dealing with the Army, Navy and higher formations, senior ranks were necessary if the Wing was to function efficiently. Due to dispersal of the squadrons, most of the Wing officers would, of necessity, spend a large part of each month away from Headquarters visiting units. If the number was reduced it would be difficult to deputize.

The Air Officer in charge, Administration, agreed with this point of view, but said that, due to the shortage of officers the argument could not stand.

Group Captain Jackson, continuing his defence of the Wing, said that efficient technical officers were necessary as the Mark VI balloon was in the experimental stage and the Ministry of Aircraft Production were anxious to receive reports with a view to improvements in future production. He concluded by saying that as a result of his visits to squadrons, he felt that the Wing had a useful function to perform which would eventually make the squadrons more efficient. All these arguments, however, were of no avail and before the conference broke up a new establishment of Headquarters, 260 Wing, was proposed, reducing the strength from 14 officers and 130 airmen to 9 officers and 25 airmen. The Balloon Repair Section was placed under No.107 Maintenance Unit and the Hydrogen Section was taken over by R.A.F. Station, Ismailia.

The Wing was placed under H.Q.202 Group (1) and lost control of all squadrons which were then or in future based outside Egypt.

Despite these initial setbacks, the Wing set to work reorganizing the barrages in the Middle East. Conferences were held with the Naval and Army authorities in connection with the siting of new barrages and the provision of defences for shipping. Arrangements were made to cover the whole of the Suez Canal which was considered by all services a vital link in the chain of communications. Much opposition was met here from Royal Air Force sources who saw balloons as a potential danger to friendly aircraft.

By its first birthday, No.260 Wing had increased the barrage under its control to 345 balloons. Its operations had not been plain sailing and many technical difficulties had been met and overcome, the main ones being those of supply, repair and hydrogen. The Balloon Repair and Hydrogen Section had not functioned satisfactorily under the units to which they were attached and had been returned, at least temporarily, to the control of the Wing.

Further Changes of Policy.

On the 2nd September 1942, the Air Officer in Charge, Administration, Headquarters, Royal Air Force, Middle East, interviewed the Officer Commanding, No.260 Wing, regarding balloon policy. The latter said that he had heard of possible changes in the organisation of the Wing but had not been asked for his views and wondered whether there was any truth in the story. The Air Officer in Charge, Administration, replied that no changes were contemplated, other than in hydrogen distribution and that the matter required review.

In spite of this assurance, Air Headquarters, Egypt,

/received a

(1) Later Air Headquarters, Egypt.

received a letter - a copy of which was subsequently forwarded to Headquarters, No.260 Wing, - setting out a new organisation policy for the Wing. The letter was dated the 29th August, 1942, - three days prior to the interview at Headquarters, Royal Air Force, Middle East.

Air Headquarters, Egypt, asked for the comments of the Officer Commanding, No.260 Wing, who replied that the letter was in direct contradiction to the remarks of the Air Officer in Charge, Administration, Middle East, and if put into operation would result in decreased efficiency. The matter was discussed with the Air Officer in Charge, Administration, Egypt, who had no previous knowledge of the letter and said it was to be cancelled. It was then arranged that a conference would be called to discuss the matter fully. In the meantime, the Wing would function as usual.

On the 29th September 1942, the Squadron Leader (Administration) of No.260 Wing visited Air Headquarters to discuss balloon organisation and was informed that the conference would not now be called. The revised organisation, as set out in the letter dated the 29th August, would stand "in toto". This was the last word and the Wing was reorganised during October.

The new policy provided for a Balloon Staff Officer, established at Air Headquarters, Egypt, to fill the dual role of Balloon Command Officer, Middle East, and Senior Balloon Officer, Egypt. No.260 Wing was responsible only for the technical operation and administration of balloons in the Delta area. All matters connected with the maintenance and supply of balloons, hydrogen and cylinders in the Delta area were controlled by Headquarters, No.206 Group, on whose staff the requisite technical officers were established. Headquarters, No.260 Wing establishment was reduced to a Wing Commander (in command) assisted by a Squadron Leader (Balloons), a Flight Lieutenant (Adjutant) and a Flight Lieutenant (Equipment), together with the normal orderly room staff.

The reason for the reorganisation is not clear and it is difficult to find any economy in personnel. It is true the establishment of the Wing Headquarters was reduced but additional officers were established at Headquarters, Royal Air Force, Middle East, Headquarters, No.206 Group, and a new unit was formed to carry out balloon maintenance and hydrogen supply. The scheme did eventually give the Senior Balloon Officer wider control, as Group Captain Jackson in his new dual appointments at Air Headquarters and Headquarters, Middle East, covered the whole Command, but this could have been achieved by reverting to the original Air Ministry intention.

Headquarters, No.260 Wing, continued to function in its reduced capacity until December 1944, during which time it continued to give good service. Its commitments at this time were considerable and included an immensely increased service of balloons to D.E.M.S. anti-aircraft gun calibration and the provision of complete squadrons, fully equipped, for advanced bases and the invasion of Sicily.

The successful absorption of Royal Egyptian Air Force personnel into the balloon defence scheme, was largely due to the work of the Wing and there is no doubt that but for its existence the balloon squadrons in Egypt would not have functioned so efficiently.

It is also clear that a controlling formation for balloons was needed in the Middle East and that Headquarters, No.260 Wing, to some extent fulfilled the need. The pity is that

/the Wing

the Wing was not allowed to function as visualised by the Air Ministry in July 1941. Had a Balloon Group been sent, under the direct control of Balloon Command, no doubt its strength would have withstood the buffetings received and control of all balloons would have remained in its charge.

Provision of Hydrogen for Middle East Balloon Barrages.

Compiled from Forms 540 of Middle East Balloon Units and the personal experience of the Middle East Command Hydrogen Officer.

The deployment of balloon barrages in the Middle East was carried out over a period exceeding three years, i.e. from the formation of No.971 Squadron in October 1940, to the arrival of No.983 Squadron in November 1943. This extremely slow rate of progress was due to a variety of causes, including lack of balloon equipment, lack of shipping space and in 1942, the urgent need for balloon protection in India. Of the balloon equipment in short supply, the most serious shortage was of hydrogen and hydrogen producing plants.

When it was decided to send balloons to the Middle East, no knowledge was available at home regarding the behaviour of balloons under the climatic conditions to be encountered. As these conditions would greatly affect the consumption of hydrogen, it was difficult to estimate the requirement in plants chemicals and ancillary equipment. The estimate of one 'A' type portable silicol plant per ten balloons given by the Director of Hydrogen Production (Lord Ridley) was, no doubt, based on the principle that it was far better to underestimate than be suddenly faced with a shortage in the field. The supply of portable plants in 1940 was limited to a few (not more than ten) reconditioned relics of the Great War, which could not be expected to remain serviceable for any length of time under field conditions in eastern countries, where repair facilities were likely to be inefficient or entirely lacking.

The Directorate of Hydrogen Production was now faced with the problem of supplying to each balloon squadron ordered overseas, sufficient portable plants to maintain its barrage at the rate of one plant, together with one in reserve, to each ten initially established balloons. As the number of plants available would support only seventy to eighty balloons it was necessary to manufacture portable plants on a high degree of priority, or retard the despatch of balloon squadrons overseas. A new version of the 'A' type portable silicol plant was designed, embodying all its basic principles with various improvements tending towards easy operation. Shortage of materials and the degree of priority accorded the work resulted in much delay before the first of these plants became available in the Middle East. By the time of their arrival, five squadrons were endeavouring to fly barrages in excess of their initial establishment with the aid of the now decrepit 'A' type plants, together with three very crudely constructed local plants to the same design.

It would appear to have been overlooked by those responsible in the United Kingdom that at Ismailia a 'C' type fixed Silicol Plant capable of producing 60,000 cubic feet of hydrogen per hour was available. This was built prior to 1930 and intended to supply the airships R.100 and R.101 with hydrogen at the staging post en route to India. At any rate it was not until July 1941 that steps were taken to overhaul and repair the plant and gasholder. Here, with a little foresight, the whole problem of hydrogen supply to the barrages in Egypt would have been solved with little difficulty. Indeed the problem should not have arisen. The 'C' type Plant had probably the highest output of any at that time in existence and could with ease produce the estimated monthly requirement of 4,000,000 cubic feet of hydrogen. Why, on the decision taken early in 1941 to

increase the barrage, steps were not taken to instal suitable compressors at Ismailia and send trained operators to the Middle East, must remain a mystery. It was not until after the arrival of Headquarters, No.260 Wing, that personnel were established for this work and the 'C' type Plant made serviceable and tried out successfully; even so the absence of compressors prevented its further use. Although efforts were made to convert and instal one oxygen compressor and one air compressor, the results did not justify their continued operation. Eventually in mid-1942, two 4-stage Reavell Compressors arrived from the United Kingdom, packed and crated and apparently ready for use. However no skilled technician was sent to instal them, the work being left to the Station Engineer (A.M.W.D.) at Ismailia, who was entirely dependent on locally recruited labour of very poor quality. When the compressors were finally installed and tested, it was found that insufficient power was available for their continued operation. To meet this setback a portable generating set was obtained from the Chief Royal Engineer, and in October 1942, all was in readiness to supply balloon squadrons in the Delta Area with compressed hydrogen.

There were at this time approximately 2,000 hydrogen cylinders in Egypt, estimated to be sufficient to supply all the gas required by balloon squadrons in the Delta and Palestine. The barrage however at this time had been increased far beyond its original establishment and in practice it was possible to supply gas for topping up only. The local transport position was not all that could be desired as no Dodge hydrogen cylinder carriers were available and Dodge 3 Ton Trucks had to be used. The "turn-round" of cylinders - estimated in the Suez Canal area at three days - was in practice much slower and in most cases averaged seven days. These difficulties could have been overcome if additional transport and hydrogen cylinders had been made available but the general position as it transpired would not have improved.

Shortly after the commencement of gas supplies from Ismailia, the Chief Royal Engineer required the return of his portable generating set. This made a return to the station electricity supply necessary, with the inevitable result that the increased load rose beyond the capacity of the alternators. The periods when compressing could take place were now reduced to daylight hours only, even so the 'C' type Plant could not be operated while the compressor was in use. At no time was it possible to operate both compressors together. In the circumstances it was surprising that compressed hydrogen was ever available from Ismailia.

Some time in September 1941 - a year before the Ismailia Plant went into production - the enterprising Officer Commanding No.974 Squadron (Sq.Ldr. W.G. Summers) prevailed upon the chief engineer at the Anglo-Egyptian Oil Company's Refinery at Suez to build a fixed 'B' Type Silicol Plant from the specification in the Hydrogen Manual Part I. This was erected at 'B' Flight Headquarters, No.974 Squadron, in October, and after various small modifications carried out by an N.C.O. lent by Headquarters, No.260 Wing, was tested and put into service before the end of the month. The immediate effect of this was to release three 'A' type plants for use elsewhere.

The 'B' Type Plant was capable of producing 10,000 cubic feet of hydrogen per hour, and under favourable conditions would work continuously for long periods. This continuity was not possible at Suez owing to lack of cooling water.

/Fresh water

Fresh water was scare and had to be piped from the refinery supply through approximately half-a-mile of pipe situated above ground. In the sun temperature which was often 120°F. the water was frequently near to boiling point when it reached the plant; it was not, therefore, possible to cool the hydrogen produced and much steam entered the nurse balloons, making frequent draining and drying necessary. To build an orthodox water cooling tower was not possible owing to lack of the necessary materials, but as a substitute, a large well to contain about 10,000 gallons of water was dug and covered with rushes. The water was constantly re-used until in the process of making four to five charges of gas it became too hot; however, during the busiest period, No.974 Squadron rarely used more than 40,000 cubic feet of hydrogen per day, so by the time this condition was reached the day's requirement was fulfilled.

Whilst the 'B' type Plant was in course of construction, search was made for a compressor to enable No.974 Squadron to supply compressed gas for the proposed Aden-Suez and various Mediterranean shuttle services. Eventually a 3-stage "Messor" oxygen compressor was rescued from the scrap-heap at the W.D. Depot in Cairo. This was overhauled and a Ford V8 motor engine adapted to supply the necessary power, and satisfactorily used to fill cylinders - of various sizes - to 120 Atmospheres, at the rate of 400 cubic feet per hour. Although the output was low it gave yeoman service and was chiefly instrumental in starting the shuttle services many months before compressed gas was available at Ismailia or Aden.

Baby Nurse Balloons

From the time of the initial deployment until October, 1942, much difficulty was experienced in topping-up deployed balloons with gas. All balloons along the Suez Canal were deployed in an almost straight line, at intervals of approximately 1 kilometre. This meant that a flight of fifteen balloons was deployed over approximately nine miles and if the Flight Headquarters with the portable silicol plant was at the half way stage, the furthest balloon to be topped up was some $4\frac{1}{2}$ miles away.

No cylinders were available for this service and balloons had either to be "walked" to the plant for topping-up (a round trip of nine miles for the furthest balloon) or some method devised whereby gas could be delivered in small quantities. It was apparent that only the nearest balloons could be brought in for gassing, even so the time taken was far too long and, as it was not possible to top-up until the cool of the evening, many balloons were not at operational height until long after the order to fly was given. To obviate this delay, squadrons made small square nurse balloons of 100 cubic feet capacity, which were filled with hydrogen and delivered by motor transport to sites, where the gas was transferred to the Mark VI by the simple process of attaching the nurse balloon to the inflation sleeve and rolling it up. This procedure had obvious drawbacks; the nurse balloons were naturally subjected to much chafing during transit and often during transference of the gas. To get the required pressure for forcing the gas into the Mark VI, many operators were known to apply their bodily weight by falling or rolling on the nurse balloons, thereby making them porous. Again when the balloons were slack and "tie-offs" inefficient, air entered with the gas and considerably lowered the purity. This, of course, added enormously to the number of deflations and in the summer of 1942 was mainly responsible for the rise in the gas consumption, in Egypt alone, to over 4,000,000 cubic feet per month.

/For this

For this reason Headquarters, No.260 Wing, decided to issue compressed gas for topping-up as soon as it became available, although the position regarding the Ismailia hydrogen compressors was so unsatisfactory.

Visit of Assistant Director of Hydrogen Production

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30.5.42.

The unsatisfactory position of hydrogen during the period 1941 and early 1942 resulted in the Director of Hydrogen Production sending his assistant to survey conditions in the Middle East with a view to setting up a steam iron plant in Egypt to produce hydrogen in the same way as in the United Kingdom. The unsatisfactory supply position regarding chemicals, especially silicol which had to be transported from Canada, made some project of this description of the utmost urgency.

The Assistant Director (Mr. W. K. Hutchinson) also visited the Persian Gulf area where it was found that a supply of hydrogen was available at the Anglo-Iranian Oil Co's Refinery, Abadan. No supply difficulty was envisaged here and as it later transpired, the barrages destined for these parts were never fully operative. (1)

Aden was also visited and arrangements made to instal plants and compressors for the operation of the Suez-Aden Shuttle Service. (2)

It was intended when the steam-iron plant was erected and in production at El Baalwa, to close down all silicol plants and supply all hydrogen from there. The static silicol plants at Suez and Ismailia would, however, be maintained in a state of readiness to start-up, should they be required. By this arrangement it was hoped to conserve the existing stocks of caustic soda and silicol and obviate the need of allocating valuable shipping space for further supplies. The new hydrogen plant was expected to be completed before the end of 1942. That this was not so was due to the fault of the Assistant Director, who had obviously not reckoned with transport and local labour difficulties.

Construction of Steam-Iron Plant

On the return of the Assistant Director of Hydrogen Production in May 1942, arrangements were immediately made to send the necessary engineers and equipment to Egypt for the purpose of installing the new plant. This consisted of a two-unit hydrogen generator by Power Gas Ltd., capable of a normal output of 4,000,000 cubic feet per month, with a peak output 50 per cent in excess of that figure; two water Gas Generators with a Cochrane boiler and water gas holder, two 4 stage Reavell Hydrogen Compressors driven by Bellise and Morcom steam engines and a 100,000 cubic feet gas holder for hydrogen together with the necessary gas and water purifiers and cooling plant. The general constructional work was carried out by local labour under the direction of skilled engineers from the United Kingdom. As this was the only plant of its type ever erected in Egypt the labour difficulties can be imagined.

The average native labourer in Egypt is concerned only with obtaining the bare necessities of life. If he can get them without working, so much the better. Should he have to work for them, then as soon as he has sufficient for his immediate needs he takes time off to enjoy them. The resultant absenteeism assumes colossal proportions.

/Another

(1) See pp. 421 - 424
(2) See pp. 418 - 419

Another cause contributing to the delay in the completion of the work, was loss of vital equipment in transit.

The plant eventually went into production in August 1943, at which time, although not completed, it was able to deal with the requirements of the reduced balloon barrages.

Reduction in Gas Consumption

During 1942 until the supply of compressed gas was forthcoming from Ismailia, the hydrogen consumption of squadrons controlled by No.260 Wing assumed astronomical figures. That the topping-up procedure previously described was the primary cause of this huge consumption is proved beyond doubt by the figures given for the year 1942. These are:-

Month	Average Balloons Deployed - Daily	Hydrogen Consumption	Consumption Per Balloon - Daily
Jan.	161.7	1,513,670	301
Feb.	182	1,580,715	310
Mar.	243	2,088,575	274
Apl.	291	3,141,700	360
May	335	4,104,350	395
June	362.2	3,827,000	352
July	365.3	4,607,560	407
Aug.	382.1	4,731,020	399
Sept.	-	-	-
Oct.	394.22	4,245,660	347.4
Nov.	388.96	3,135,140	268.7
Dec.	356.9	2,255,060	203.8

The compressors at Ismailia went into operation during October 1942, and early in November, compressed gas was issued to squadrons in the Delta area for topping-up purposes only. A rapid decline in consumption resulted immediately, and although it may be argued that the fall coincided with the passing of the hot season, it should be remembered that November and December are rarely the coolest months of the year in the Middle East.

In the early part of 1943 the process of supplying topping-up gas only was continued, the thinning-out of the barrages, prior to the invasion of Sicily making no appreciable difference to the total requirements, owing to increased demands from D.E.M.S., the Port and Beach Detachments preparing for Sicily and the necessity for supplying No.977 Squadron at Tobruk and Benghazi. When these commitments had been fulfilled the Delta squadrons were supplied with hydrogen for all purposes and the average daily consumption showed a further reduction.

In August 1943, some difficulty arose in connection with the compressors at Ismailia. The necessary pressure - 2,500 lbs per square inch (1) - was unobtainable and it appeared for some time that the barrage would be grounded, but by speeding up turn round and compressing to 1,800 lbs per square inch the compressors held out until the plant at El Baalwa went into production. The trouble at Ismailia, was found to be due to excessive carbon given off from the silicol during manufacture of hydrogen, combining with the oil used for lubrication of the compressor cylinders, and causing excessive wear on the 4th stage piston. It subsequently transpired, that this was affecting compressors in all commands and was in no way due to any abnormal feature likely to arise in hot climates.

/By the

(1) Set by Assistant Director of Hydrogen Production to counteract possible danger due to heat expansion.

By the time the plant at El Baalwa started production, the last big commitment in the Middle East had been completed and the daily demand for hydrogen was easily dealt with. Indeed on numerous occasions the plant was put on "stand by" for several days due to the lack of empty cylinders available for refilling.

Distribution Problems

Distribution was faced with two major problems:

(a) lack of transport and

(b) lack of co-operation on the part of balloon flights in collecting cylinders from sites.

It was originally intended that the distribution centre would deliver three cylinders per balloon to each site and call each day to exchange empty cylinders for full cylinders on a "milk round" basis. No difficulty was foreseen as most balloons were bedded in groups of three at parent sites, two being taken to their war sites on the order to fly. With nine cylinders of hydrogen at each parent site it was possible to top-up and in addition make one rapid inflation should an urgent need arise, such as the loss of all three balloons. (1) The extension of the barrage to Tobruk and Benghazi, with the resultant high degree of priority given to this area, together with the need for conservation of transport, prevented the continuance of this scheme and it was decided to deliver as required to sites at the same time as the daily delivery of stores, rations, etc.

To give the Hydrogen Distribution Officer knowledge of his daily requirements, an addition was made to the Daily 'May-fly' Return (2) showing the number of full and empty cylinders held by flights. This scheme worked well for a time, but later, as was perhaps inevitable, it broke down due to lack of co-operation on the part of flights and individual operators on sites. Often the 'May-fly' would show few full cylinders and many empties. Upon receipt of this, a consignment of cylinders was despatched. On arrival at the flight, the driver was told that no transport was available for collecting the empties, he could either collect them himself or return without them. As it was at no time possible to collect at parent sites and return to the filling station on the same day, the driver - being aware of the extreme shortage of transport - would usually elect to return empty-handed.

Some balloon operators, gravely troubled by the lack of bedding-down equipment, saw in the empty hydrogen cylinder the answer to their many prayers for additional sand-bags. Flight commanders appeared to think the idea an excellent one, at all events very few discouraged it. This scheme assumed such large proportions, that the Hydrogen Distribution Officer was forced to swoop upon selected sites, armed with gas key and pressure gauge, and later lodge a complaint with squadron commanders regarding the dangerous misuse of this item of equipment.

When the Royal Egyptian Air Force took over all balloon sites in the Delta area the distribution to flights became impossible. Within a short time, it was known that Egyptian balloon operators regarded hydrogen cylinders as very ordinary equipment and handled them, whether filled or empty, very carelessly. That no accident occurred was due to the

/goodwill

(1) This frequently occurred due to sudden high wind.

(2) Daily Return of Balloon State.

goodwill of Providence and the excellent workmanship of the British steelworker. In these circumstances and with anxiety not to try Providence too far, the "milk-round" system was again put in action, the driver of the truck standing-by during off-loading to supervise the native airmen.

The original estimate for the turn-round of cylinders in the Canal area was three days. That it was never possible to get down to this figure was due to the reasons mentioned above. The average turn-round of cylinders in all areas was :-

Canal area	7 days
Alexandria	10 days
Levant	14 to 18 days
Benghazi-Tobruk	6 weeks to 3 months.

All deliveries were made by road, except in a few instances to Benghazi and Tobruk, when priority was obtained on rail or ship. Generally speaking, shipping space was impossible, and rail transport depended on degree of priority which, in the case of balloons, was at this time very low.

/SECTION 24.

SECTION 24

EXPERIMENTAL BALLOON UNIT - SINGAPORE.

With the posibility of sudden action by the third signatory to the 'Tripartite Pact' ever in mind, the Air Staff released that it might be faced with a sudden demand for extensive balloon barrages in the Far East. It was further realised that as no experience was available regarding the behaviour of balloons under the intense tropical conditions likely to be met, squadrons would have to "grope in the dark", at a time when immediate and efficient deployment was essential. To obviate those difficulties it was decided in April, 1941, to send a small experimental balloon unit to Singapore.

AA6/SD/34/S/11 ~~KEC/S.51055/~~ ORG.Enc.1A 4.4.41.

The unit was not in the nature of a complete barrage but would fly two Mark VI balloons only, take observations of their behaviour and report on their suitability. The detachment consisted of two officers, four balloon operators and three airmen skilled in balloon manufacture. Equipment taken provided for two initial equipment Mark VI balloons plus eighteen in reserve,(1) two Wickham and two hand winches together with the necessary ground equipment. In addition to obtaining data the party were to examine the possibility of local manufacture of balloons.

Once again the main limitation would be due to lack of hydrogen, none being obtainable locally. To overcome this difficulty it was suggested that coal-gas - of which there was a plentiful supply - could be used. It was left to the Engineering branch of Headquarters, Balloon Command, to point out that the Mark VI Balloon, complete with fins and rigged for flying, weighed 110 lbs. and had a cubic capacity of only 2,300 cubic feet. As the lift of coal-gas was approximately 37 lbs. per 1,000 cubic feet in hot climates, the total lift of a fully-inflated Mark VI balloon would be insufficient to raise it from the ground. It was therefore necessary to add to the unit's establishment one "A" type, portable silicol plant and three hydrogen workers.

1B, Enc.7C 7.4.41.

To assist the preparatory work of the unit on its arrival, the Air Ministry sent a questionnaire to Air Headquarters, Far East, who in their reply indicated the more vulnerable targets in order of priority. The reaction to the proposal, however, was unfavourable, Air Headquarters, Far East commenting:-

> "War with Japan will be short and sharp, i.e. naval expedition probably backed by land attack from Thailand starting 400/500 miles from Singapore. Therefore balloons will be of temporary use only, there will be no sustained bombing as in United Kingdom.
>
> It is doubtful if expenditure of manpower, transport and material is commensurate with the results hoped for. Suggested that the effort would be far more effective translated into squadrons of aircraft.

/Both

(1) It was anticiptated that much static condition would be present therefore 9 balloons were wire rigged and 9 balloons rope rigged.

Both Singapore Island and mainland opposite Penang island are operational areas for our own aircraft. On Singapore island we have four aerodromes, one within 1½ miles and one within 3 miles of the main enemy objective - Naval Base and Senoko - one on the outskirts of Singapore town and the fourth within four miles of Kranji and Woodlands. Four miles from Butterworth we have an operational aerodrome and within twenty miles of Butterworth a further three.

Both at Singapore and Penang aircraft will be operating over both target and balloon areas .... it would appear that balloons over Singapore island or mainland opposite Penang would be a danger to our own aircraft at any height. At Rangoon they could be accepted up to 2,000 ft."

1B Enc. 9A. 20.4.41.

Despite the unfavourable comments the unit embarked for Singapore with instructions to prepare a full reconnaissance report of balloon protection, if experiments were successful. Shortly after arrival, however, it became known that all equipment had been lost at sea. Nevertheless the Officer Commanding the Experimental Balloon Unit, carried out a comprehensive survey of the Singapore area and reported unfavourably on the possibility of providing an efficient balloon barrage. Extracts from his report, signalled to the Air Ministry, were that:-

S.70911 En.11A 18.9.41.

"I consider balloons not suitable for the following reasons:-

(a) Adequate barrage would require 150 to 200 balloons which would prove a danger to our own aircraft.

(b) Few natural sites available, provision of others difficult.

(c) Certainty of high losses from lightning with consequent ground fires - majority of local dwellings inflammable.

(d) No craft available for necessary waterborne sites.

(e) Great difficulties regarding transport of portable gas plant and provision for a damp-free storage for chemicals at sites.

(f) Cloud conditions rarely such that balloon could be flown without giving away ground targets."

This was in effect a repetition of the original objections raised by Air Headquarters, Far East, who supported the suggestion of the Officer Commanding the Balloon Unit that the experiment be abandoned.

On receipt of this report the Air Ministry acted upon the recommendations and cancelled the replacement of the lost equipment. So ended a project from which much useful knowledge might have been gained.

SECTION 25

BALLOON BARRAGES - NORTH-WEST AFRICA AND CENTRAL MEDITERRANEAN AREA

MALTA

In 1940, Malta was given high priority in the list of overseas areas requiring balloon protection and was to be the destination of No.972 Squadron. A preliminary reconnaissance of the island was carried out by the Officer Commanding, No.971 Squadron, in January 1941, but the scheme was abandoned in favour of the more pressing need for a barrage over part of the Suez Canal.

No futher action was taken until an urgent request from Malta was received by Headquarters, Royal Air Force, Middle East, in January 1943. It was then decided to provide from Middle East resources a flight of fifteen Mark VI balloons to be flown over the Fleet anchorages and installations of the Grand Harbour at Valetta. Reconnaissance revealed that owing to the closely built-up nature of the area, grouped siting(1) would not be possible. The close proximity of Luqa aerodrome necessitated speedy operational control, making the provision of power winches essential. Most of the sites selected to provide protection for the Grand Harbour were at the top of the bastions and made access from the seaward side impraticable. It was, therefore, necessary to inflate the balloons on their sites, making the provision of a hydrogen compressor plant in the Island of the utmost importance. To meet this requirement a four-stage compressor was transferred from Aden where No.1436 Flight had been recently reduced to a cadre basis.

No.983 Sqn. F.540.

It was decided to select only fully experienced personnel for the Malta barrage, and to this end the Delta squadrons were instructed to supply between them 70 balloon operators and 6 hydrogen workers, who were transferred to No.983 Squadron, which had recently arrived in Egypt from Paiforce. The original personnel of No.983 Squadron were posted to various balloon units in the Delta area and the squadron was reformed on a one-flight basis under a new commanding officer.

The squadron arrived in Malta on the 22nd February, 1943, and by mid-March, twelve balloons were ready for operation, of these, three were found to be in the path of aircraft operating from the aerodrome and were resited. By the end of the month twenty-one balloons were operative. The wisdom of employing only experienced balloon operators was fully justified when the squadron was informed that only twelve minutes could be allowed for balloon operation, this time to include the transmission of messages from Fighter Control to individual sites.

Enemy air raids met by heavy anti-aircraft gunfire resulted in many balloons becoming casualties. On one occasion 90 per cent of the barrage, whilst bedded, was destroyed by shell fragmentation.

The island saw very little enemy air activity after the invasion of Sicily but the barrage remained operational until the 21st January, 1944, when it was deflated and the squadron moved to Corsica.

/NORTH-WEST AFRICA

(1) Bedding of balloons in groups at a parent site to save personnel; balloons are 'walked' to operational sites as required.

NORTH-WEST AFRICA

F.540. On the 29th July, 1942, No.985 Squadron was formed at Chessington for duty overseas, its establishment providing for a barrage of forty-five Mark IV balloons. The squadron did not proceed overseas until the 22nd December 1942, disembarking at Algiers on the 3rd January 1943, and subsequently moving to Bone where, on the 29th January, seven balloons were flown. By the end of the next month the barrage had been increased to twenty-six balloons and an additional barrage of twelve balloons was in operation at Philipville. Equipment difficulties caused subsequent reductions in the barrage, the many casualties, due to anti-aircraft fire, being irreplaceable. In may 1943, No.981 Squadron arrived at Bone and came under the control of Headquarters, North African Air Force.

On the 13th May 1943, a barrage of fifteen balloons was raised over Bizerta by No.985 Squadron. This was handed over to No.981 Squadron on the 16th May, who in addition provided barrages at La Goulette and Ferryville by the end of the month. In June 1943, the barrages were extended to Pantelleria where No.982 Squadron, newly arrived from the Middle East, flew ten balloons.

July saw the invasion of Sicily for which all three squadrons provided beach parties. The success that met the Allied efforts in Sicily resulted in decreased enemy air activity in North-West Africa, and on the 9th August 1943, the Ferryville barrage was deflated, followed on the 9th September by the barrage at Bone. A few days later on the 20th September, No.985 Squadron sailed for Italy. No.987 Squadron continued to operate at Bizerta and Ferryville, and in addition took over the barrage at Bone from No.985 Squadron. All remained in operation until May 1944, when they were deflated and the squadron was reduced to a "number only" basis.

No.982 Squadron moved to Algiers and Oran in October, 1943, continuing at both places until July 1944. During the following month it proceeded to Italy but found on arrival that it was not required and was reduced to a "number only" basis.

During the life of the barrages in North-West Africa the weather took a heavy toll of the balloons. Unforecasted high winds and electrical storms were at times responsible for the destruction of large numbers of balloons whilst in the air.

SICILY

The Initial Assault. The balloon protection provided for the initial assault on Sicily comprised two Beach detachments each equipped with 12 balloons. Personnel of each detachment comprised 1 officer, 1 sergeant, 6 corporals and 12 aircraftmen. The equipment pack-up contained:-

SASO/OO/74
Encl.13
21.5.43.

	Assault Stage	Maintenance (To follow)	
Winches	6	1	
Cylinders Hydrogen	60	60	
Balloons	12	12	
Bombs	12	12	
Drums	12	12	
Parachutes	12	12	
Inflation sets	6	1	
M.T.	-	1	1 - 15 cwt truck fitted with winch

/Instructions

Instructions to Balloon Detachments were issued by Headquarters No.141 Force under reference 141F/RAF/260/AIR/(P) dated the 7th May 1943.

> "At the last possible moment before leaving the port of departure each party will inflate its 12 balloons and attach them to the selected landing craft leaving empty containers and anything necessary with the Port Embarkation Officer.
> On the beaches as no natural anchorages will be found .....it is recommended that a well-filled sandbag weighing between 60 and 70 lbs. be attached to the end of the cable. This provides a practical weight for a man to carry ashore and if no further anchorage is found on arrival, will be sufficient to hold a balloon to the ground in a breeze up to 15 m.p.h. until the servicing party can make a more permanent anchorage. An additional empty sand-bag can be carried ashore and if the circumstances permit be quickly filled and added to the original. The weather at the time of landing obviously will be the deciding factor as to the weight of the anchorage required.
> The men who place the balloons having completed this task will return in the landing craft and the maintenance party will endeavour to establish a plan for stores and any further inflations and repairs."

The method of siting the beach barrages would be; six of the balloon-carrying landing craft to beach and the balloons to be carried ashore and sited in staggered positions up to a depth of 200 yards, over a frontage of 1,000 yards. The remaining landing craft would then beach over the same frontage and the balloons thus carried, sited in staggered positions, at a distance in excess of 200 yards from the sea.

The Follow Up

The Port Detachments were intended to operate at Augusta and Siracuse, which would in the early stage of their capture be protected by twenty and fifteen balloons respectively. Here again the operation would be in three stages and was arranged as follows:-

FIRST STAGE

AUGUSTA	SIRACUSE
Personnel	**Personnel**
1 Officer	1 Officer
1 Sgt.) Balloon	1 Sgt.) Balloon
2 Cpls) Operators	1 Cpl) Operators
18 A/cs)	11 A/cs)
2 A/cs D.M.Ts.	2 A/cs D.M.Ts.
1 Cpl Fitter Marine	2 A/cs ACH/GD
2 A/cs ACH/GD	1 A/c M.B. Crew
Equipment	**Equipment**
20 Balloons I.E.	15 Balloons I.E.
10 I.R.	5 I.R.
1 Winch mounted on 15 cwt truck	1 Winch mounted on truck
1 Hand winch	1 Hand winch
150 Cylinders Hydrogen	100 Cylinders Hydrogen
20 Wickham drums with 2,000 ft. cable-lethal attachments, small quantity of balloon gear-anchor cable, sand-bags, etc.	15 Wickham drums 2,000 ft. cable and lethal attachments, small quantity of balloon gear
1 Three ton truck	1 Three ton truck
1 Marine Tender 24'	1 Marine Tender

/SECOND STAGE

SECOND STAGE

AUGUSTA	SIRACUSE
Personnel	Personnel
1 Officer	1 Officer
2 Cpls } Balloon	2 Cpls } Balloon
18 A/c } Operators	18 A/c } Operators
2 A/c D.M.Ts.	2 A/c D.M.Ts.
2 A/c ACH/GD	2 A/c ACH/GD
3 Hydrogen Workers	3 Hydrogen Workers
Equipment	Equipment
30 Balloons	20 Balloons
1 Swift and machine	1 Hydrogen Plant
1 Portable Hydrogen Plant	3 Canvas water tanks
3 Canvas water tanks	4 Tons caustic soda
5 Tons caustic soda	4 Tons silicol
5 Tons silicol	1 Nurse balloon
1 Nurse balloon	1 Hand blower
1 Hand blower	
1 Three ton truck	
1 - 15 cwt truck with winch, small spares tentage, etc.	

THIRD STAGE

Up to Flight strength	Up to Flight strength

Form 540.

The Beach and Port Detachments were selected from Nos.972, 975, 977 and 985 Squadrons. It was intended that the parent units would proceed to the island at a later date, reform, and provide barrages as required.

Wasted Effort

It can be said that the initial phase was a great success the detachments doing all that was required, and in addition giving valuable assistance in unloading stores etc. The same cannot be said of the organization covering the follow-up operations.

SASO/CC/74
Enc.13C
30.8.43.

Early in August 1943, No.975 Squadron arrived in Sicily and took over control of the port defence of Augusta, flying 30 balloons. At the same time No.972 Squadron took over at Siracuse. No.977 Squadron, however, were not so fortunate and on arrival found that they were not required and were left to wander through the island looking for work to do. The Officer Commanding in a letter to the Senior Staff Officer, Balloons, Middle East, wrote:-

> "One officer and about 120 men with rations landed at Palermo, whilst the balance were landed at Licato on the South Coast....The Licato contingent of which I was one duly set off for Palermo with no maps and no knowledge of what the roads were like. The distance is about 120 miles. We set off with a light heart glad to know that at last we were going to do a job of work. After 12 hours driving everyone was tired so we slept in the mountains, our total mileage was 86 miles....We arrived in Palermo about mid-day and imagine our disappointment at seeing a barrage flying; once again we were forestalled, this time by the Americans who had got their "batteries" at every place where a port existed no matter how small.....

/We were

We were then placed in a staging area situated in a lemon grove, the place looked charming and we stayed for a week. It was the most disgusting place I have ever been in, very hot and no attempt at sanitation.....

Generally speaking the men are fit but have had quite a few go down with high temperature, the chief moan is lack of English mail.....

All English Units on the west side have no idea whom they come under, some are under M.E. and some N.W.A.A.F. and some under everyone. We have been nearly 8 weeks sleeping in or under a wagon."

On to Italy.

Although other squadrons taking part in Sicily fared rather better than No.977 Squadron, none was fully employed and many appeared to be unnecessary. Eventually the bulk of these units were sent to Italy, where, in October they were operating as under:-

No.972 Squadron.....	Taranto	15 Balloons
	Howe Beach	7 "
	Reggio	8 "
No.975 Squadron.....	Bari	
No.977 Squadron.....	Naples	
	Salerno	

The barrage at Augusta continued to be flown by a unit known as X Squadron which was later reinforced by various beach parties and re-numbered No.986 Squadron. On the 12th June, 1944, all balloons were deflated and the squadron moved to Naples.

Balloon barrages in Italy were constantly changing location but the main towns covered were Taranto, Brindisi, Bari and Naples. Among the places which received balloon protection for short periods - mainly to cover store dumps and communications - were:-

No.972 Squadron.....	Manfredonia
	Ortona
No.975 Squadron.....	Manfredonia
	Barletta
	Ancona
No.977 Squadron.....	Bagnoli
	Castellammare
	Annunziata
	Baia
	Vomero Heights
No.985 Squadron.....	San Stefano
	Piom Bino
	S. Marienella
	Civitavecchia
	Leghorn (30 Balloons)

Italians Co-operate

Soon after arrival in Italy the squadrons received detachments of Italian co-operators who were trained in balloon handling. These quicly became accustomed to our methods and enabled many British airmen to be remustered to other Air Force trades, sadly in need of personnel. Many of the original members of Middle East balloon squadrons were due for home posting, these too were released by the Italian reinforcements.

/Of the

Of the squadrons operating in Italy, No.972 Squadron was reduced to a "number only" basis in April 1944 - Nos.977 and 985 Squadrons in September 1944, No.975 Squadron in October 1944 and No.986 Squadron in April 1945.

On being disbanded No.986 Squadron received a congratulatory signal from the Air Officer Commanding-in-Chief, Mediterranean Allied Coastal Air Forces, which read:-

> "The disbanding of an operational unit because its task is done is a natural corollary to successful achievement. Although the last shot has still to be fired the German Air Force has been smashed before the defence which it could never break and No.986 Squadron has played its allotted part in that defence. Your retention in this theatre when other squadrons had to be withdrawn was in itself a tribute to your keenness and efficiency, and in wishing all ranks goodbye I want you to know that your work has not gone unnoticed particularly by the Navy who have always been full of praise for the efficient manner in which you were affording them protection. Good luck to you all."

Corsica

After the conquest of Sicily, air activity over Malta was practically negligible and the balloon barrage was deflated. No.983 Squadron was despatched to Corsica and duly arrived on the 1st March 1944 at Ajaccio. Later, Headquarters were set up at Bastia and the squadron was reorganised into three flights by incorporating two detachments of No.982 Squadron operating in Sardinia. In addition a flight was formed at Pirto. The squadron personnel now numbered 6 officers and 205 airmen.

In April the barrage was increased by eight balloons and further increased to forty-five I.E. in June 1943. Enemy air activity over Corsica was not of a serious nature, but many balloons were lost due to bad weather and inaccurate meteoroligical forecasts.

On the 16th June, a balloon detachment was provided for the assault on Elba, the operation being carried out successfully. One airman of the party was killed during the assault. Balloons continued to be flown over Elba until the 6th July 1944.

The behaviour of balloon personnel on this operation was most praiseworthy. Balloon Operators carried out many duties in addition to their own, including the unloading of stores and mules, assisting the wounded and police duties after dark; all under heavy shell and mortar fire.

In July the Corsica Barrage was reduced to two flights totalling twenty-seven balloons at Bastia and Ajaccio and in August to twelve balloons only. At the end of August No.983 Squadron was reduced to a "number only" basis, and the personnel dispersed some to return to the United Kingdom, others to reinforce Royal Air Force units in the Central Mediterranean.

SECTION 26

BALLOON BARRAGES - INDIA, BURMA AND CEYLON

INITIAL PROPOSALS.

S.5694 Encl.1A 19.7.40.

The possibility of flying balloons in India was first considered by Air Headquarters, India, in July 1940. It was proposed to operate a number of small barrages in various passes, such as the Khyber Pass, to act as a deterrent to low-flying aircraft,(1) which were making illegal flights into the country.

Recruitment and training of personnel, and manufacture of the necessary equipment, it was thought, could be undertaken in India. To this end Air Headquarters, India, requested that the Air Ministry send samples of balloons and ancillary equipment to enable flying tests to be made, and to assist investigation into the possibilities of local manufacture. A few experts in balloon operations were also required to train locally enlisted crews.

ibid. Min.2. 30.7.40.

At the Air Ministry the project was referred to the Planning Branch who took the view that no objections would be raised to the proposed barrages if we were at war with Russia. As no state of war between Britain and Russia existed, it was suggested that the proposed barrages would require consideration from the political point of view.

It was anticipated that the production of hydrogen would be a limiting factor to the successful operation of the barrages. Even allowing for the possibility of India manufacturing its own balloons, the Air Staff considered it doubtful that a supply of hydrogen would be available locally. The supply of hydrogen would, therefore, depend entirely upon manufacture by portable silicol plants, for which silicol would have to be imported from Canada. The lack of silicol plants was the primary cause of our inability to provide balloon barrages in the Middle East and it was felt that the need in India was not so great as the need there. Nevertheless if India could be self-supporting in this respect, it was thought that it might be possible to extend manufacture and so supply the Middle East - with balloons at least - from that source.

ibid. Min.11 9.8.40.

Objections to the plan in its present state came from the Organisation Branch, who pointed out that to guard against any possibility of a premature termination of the experiment through loss of the sample balloon, at least three additional balloons should be sent. It was further pointed out that the balloon technicians estimated that the life of a balloon in India would not exceed six weeks, compared with six months in United Kingdom. Futhermore, balloons sent to India would need to be specially treated against excessive porosity.

In spite of all the objections raised the Director of Plans decided that the equipment asked for by Air Headquarters, India, should be sent. He agreed that to do so would result in gaining experience of flying balloons under tropical conditions and might develop a new source of supply.

/The Dunlop

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(1) Origin of aircraft not stated but believed to have been Russian.

The Dunlop Rubber Company were approached with a view to manufacturing balloons at their works in India should the experiment prove successful. They were requested to send their Indian company samples of fabrics so that the matter could be fully discussed with the Indian authorities.

The India Office was informed of the proposals and asked if India would agree to bear the cost of the trials. On the 9th November, 1940, a reply was received from the Defence Department of the Government of India stating that if the necessary personnel, plant and materials were sent they would be prepared to pay for them. At the same time it was pointed out that usually for Air Force tests of this nature the Air Ministry supplied the materials on loan. It was requested that this procedure be adopted in the present case.

Army Requirements

8755/34/40/ AIR Encs.1A to 3A Aug.1940.

Meanwhile in India, the General Staff were suggesting that some form of light balloon barrage should be provided for the protection of detached posts against possible enemy dive-bombing attacks.

Air Headquarters, India, informed the Army Authorities that the question of providing balloon barrages was already under consideration by the Air Defence Sub-Committee. If it was decided to adopt them, their provision would be the responsibility of the Royal Air Force. The General Staff, however, visualised a simple type of small balloon, which could be easily handled by personnel at the posts concerned. Similar protection, it was thought, could be used by mechanical transport convoys in the Indian Desert. As they could not see how the Royal Air Force could be responsible for protection of this kind, the matter was not pursued further.

THE PROJECT ABANDONED

At home new objections to the Indian experiment had been raised. In a minute to the Director of War Organisation on the 25th November, 1940, the Operations Branch set out in detail the estimated personnel and equipment required to maintain a barrage of 24 balloons in India. These figures were so staggering that the matter was placed before the Assistant Chief of the Air Staff who, in referring it to the Director of Overseas Operations, said:-

S.5694 Min.53 25.11.40.

> "The question is, I think, an operational one and not for me to answer, but I ought to state that I consider the use of a balloon barrage in the Indian passes to be operationally unpracticable, bearing in mind the nature of the terrain and the difficulties of communication. Moreover the air currents in the North-West Frontier mountain area, especially in the passes, are of great violence.
>
> I cannot see that the expenditure of effort could possibly be justified."

The Director of Overseas Operations was in full accord with this statement and suggested that the India Office be recommended to abandon the whole project. As far as gaining experience of operating balloons under tropical conditions was concerned, it was agreed that the recently-formed barrage at Alexandria would provide all the information required. This decision was duly communicated to the Secretary of State for India. Although L-Z balloons were not used in India, the results achieved since 1942, with the Mark VI balloon, would

/appear

appear to indicate that this initial experiment was abandoned on an entirely inaccurate estimate of hydrogen consumption. The figures given by the Operations Branch in their minute to the Diredtor of War Organisation were based on the necessity to reinflate each balloon every three days. At this rate a squadron of 24 L-Z balloons would require yearly:-

Silicol	1,460 tons
Caustic Soda	2,920 tons
Grease	18,900 lbs.
Coke	457 tons
Water	8,760,000 gallons.

Subsequent operations of Mark VI balloons showed that although deflations, due to porosity and purity, were fairly high, comparative figures did not approach this estimate.

Naval Requirements

8755/40/34 AIR. Enc.4A Dec.1941.

The question of a balloon barrage for India was not raised again until October 1941, when at the 22nd meeting of the Chiefs of Staff Committee held on the 9th October, a scheme for providing balloon protection for the Calcutta river was discussed. War with Japan seemed imminent and the Naval authorities at Calcutta anticipated possible minelaying by low-flying aircraft in the stretch of the river between Calcutta and Kantabarra. Mine-watching posts were to be set up, and it was decided to ask for balloons to be deployed along the 46 miles between these two points to act as a deterrent to such aircraft. It was considered inadvisable to fly balloons from vessels moored in the upper reaches of the river owing to possible interference with shipping. Between Hooley Point and Diamond Harbour, however, the river was about one mile wide, and as it was intended to provide a number of moored barges for mine-watching it would be possible to site balloons on some of these.

ibid. Enc.5A 24.12.41.

By December 1941 our relations with Japan had so deteriorated that an attack could be expected at any moment. Consequently, immediately following a further meeting of the Chiefs of Staff, the Air Officer Commanding-in-Chief, India, signalled Air Ministry urging the early provision of balloon protection for India and Burma. It was suggested that the threat of minelaying by aircraft in the approaches to both Rangoon and Calcutta was more imminent than in the Persian Gulf, and he requested that the three balloon squadrons due to arrive at Basrah in February, March and April, be diverted to India. Headquarters, Royal Air Force, Middle East, fully alive to the danger threatening from the East, agreed to the proposal, although it meant loss of valuable units that might be required at no distant date to protect the vital oilfields of Iran.

The Air Ministry, however, were not prepared to send balloon units to India and Burma in view of an unfavourable report rendered by the Officer Commanding, Singapore Experimental Unit.(1) Instead Headquarters, Royal Air Force, Middle East were requested to send to India, a balloon officer with experience in tropical areas to reconnoitre and make recommendations direct to the Air Ministry. Wing Commander G.M. Trundle, Senior Balloon Staff Officer in the Middle East was selected and proceeded immediately to Rangoon.

/The Naval

(1) See page 438.

ibid. Enc.12A 13.1.42.

The Naval authorities at Rangoon asked for the early establishment of a balloom barrage to protect shipping in the Rangoon river, the port installations at Rangoon, and the oil installations at Syriam and Thilawa, from low-bombing attacks. It was estimated that weather conditions would be favourable to flying for seven months of each year. During the monsoon period the barrage would need to be close-hauled and its usefulness reduced to that of a scarecrow. Two squadrons, each of 45 balloons, were asked for, but, as it was realized that some time would elapse before these were available it was requested that the Singapore Unit, now in the Middle East, be sent to Rangoon to provide a small temporary barrage. Calcutta was also surveyed and reported on favourably.

On receipt of these recommendations the Air Ministry acted with commendable speed. No. 978 Squadron already at sea, en route to the Persian Gulf, was diverted to Bombay and No. 979 Squadron, forming at Royal Air Force Station, Hook, was embarked on 13th February, 1942. No. 274 Wing, Headquarters Unit, was formed and despatched to India to join a nucleus supplied by Headquarters, Royal Air Force, Middle East. In addition No. 980 Squadron, formed in July 1941 for duty with the Royal Navy, was en route to Ceylon.

Indianization of Balloon Squadrons

ibid. Enc.26A 5.2.42

At this time the shortage of manpower, already acute, was becoming more serious. It had been possible in this instance to meet an urgent demand by a simple switch of units from one place to another, but it was realized that such a move could not be repeated. In any case the Persian Gulf commitment remained and would need to be met by the formation of additional squadrons. This could be accomplished by using some of the manpower "thrown up" by the policy of introducing the W.A.A.F. into balloon trades. Even so the needs of the balloon barrages could not be allowed to interfere with the necessary expansion of other branches of the Service. Furthermore it was realized that the barrages overseas would in all probability require expansion. To meet this necessity should it arise, and in an effort to release balloon tradesmen for other duties, the Air Ministry requested that an investigation should be made into the possibility of training certain selected Indians of above average intelligence to undertake duty in balloon trades. Both the Air Officer Commanding-in-Chief and the Defence Department of the Government of India agreed that suitable personnel could be found, and eventually many officers and airmen were enlisted into the Indian Air Force for these duties. Ultimately, Indians outnumbered British personnel by four or five to one, and proved very satisfactory.

Initial Deployment

ibid. Enc. 40A 17.3.42

The rapid progress by the Japanese armed forces made the plans for the deployment of balloons obsolete, even before they could be put into effect. The loss of Rangoon released two squadrons earmarked for that area, for duty elsewhere. It was now proposed by Air Headquarters, India, that the balloon squadrons be deployed as follows:-

No. 990 Squadron...	Trincomallee
No. 978 Squadron...	Calcutta
No. 979 Squadron...	Colombo
No. 980 Squadron...	Calcutta

/Headquarters, 274

ibid. Enc.59A 21.3.42.

Headquarters, 274 Wing, would also function from Calcutta. The Air Ministry, however, would not agree to two squadrons operating in Calcutta while the oilfields at Abadan remained without protection. On the 20th March, 1942, Air Headquarters, India, were notified that No. 980 Squadron would proceed to Basrah and subject to the deployment of No. 990 Squadron to Trincomallee, Air Headquarters, could have a free hand in allocating the remaining balloon squadrons.

No. 980 Squadron was eventually replaced by No. 984 Squadron, which was despatched to India after the depredations in the Persian Gulf were made good. It arrived at Bombay in October, 1942, and filled the need for a second barrage in Ceylon, No. 979 Squadron meantime having been deployed at Jamshedpur.

Rover Flights

274W/S.214/ Org. Enc.1A 6.7.42.

The continued advance of the enemy, and the subsequent widespread air attacks stretched the resources of No. 274 Wing to the utmost. In July 1942 Air Headquarters, India, decided to raise three mobile balloon flights from existing sources, to operate at short notice in any area. Nos. 978, 979 and 990 Squadrons were each instructed to earmark one flight. Equipment pack-ups were assembled and each flight was made capable of operating independently should the need arise. Personnel were carefully selected and those who had suffered from climatic conditions were excluded. All airmen were fully armed with rifle, bayonet and 150 rounds of ammunition.

Although it was realized that the provision of a full flight would seriously reduce a squadron's capacity to operate a full barrage, all were ordered to fly as many balloons as possible above the normal quota of the remaining two-thirds strength. Should one flight only be required, two squadrons would each provide one half of a flight. For this reason two schemes were implemented as set out below, each squadron being required to operate Scheme One or Scheme Two as detailed:-

274W/S.214/ Org. Enc.28B App "A" 24.9.42.

SCHEME ONE						SCHEME TWO			
OFFICERS - 1 F/LT (BALLOONS)						1 F/O (BALLOONS)			
TRADE	F/SGT	SGT	CPLS	A/CS	TOTAL	SGT	CPLS	A/CS	TOTAL
Balloon Optr	1	1	6	48	56	1	3	24	28
ACH/GD	-	-	1	5	6	-	-	3	3
HYD/WKR	-	-	-	3	3	-	-	1	1
D.M.T.	-	-	1	3	4	-	-	1	1
M.T.M.	-	-	-	1	1	-	-	1	1
MTR/CLST	-	-	-	1	1	-	-	1	1
Clerk/GD	-	-	-	1	1	-	-	1	1
Nursing Ordly	-	-	-	1	1	-	-	1	1
Cook	-	-	-	2	2	-	-	1	1
Telephone Optr	-	-	-	2	2	-	-	-	-
TOTAL	1	1	8	67	77	1	3	34	38

The Barrages in Operation

(a) Ceylon

8755/34/40/ Air Enc. 37A 13.3.42.

On arrival in India No. 990 Squadron was ordered to proceed to Ceylon to provide a barrage at Trincomallee. The balloons were sited to afford the maximum protection against low-flying

/attacks

attacks and possible mine-laying operations in the inner harbour. The barrage was placed under the direction and control of the Senior Naval Officer in Charge.

The whole squadron was deployed:

"A" Flight operated on the south side of the harbour and in the inner ring of the inner harbour. Included in this area were the Naval Yard, and Inner Harbour Road from China Bay to Trincomallee.

No. 990 Sqdn Form 540

"B" Flight controlled the outer ring of balloons, which ranged from China Bay to Trincomallee Road, and those on the east-side of the barrage area.

"C" Flight was made responsible for waterborne sites all of which were uncontrolled.

The squadron formed part of a mobile Naval Base defence organization and was in consequence equipped to a scale in excess of the normal Mark VI Balloon Unit. It carried enough cylinders of hydrogen to make the initial inflation of the barrage and was equipped with three of the new "B2" type silicol plants. The barrage was quickly operational; nine balloons were flown on the 1st April, 1942, the total being increased to twenty, two days later. Further expansion of the barrage was somewhat delayed due to lack of labour needed to unload equipment from the ship.

Difficulties were encountered in connection with hydrogen production. The water supply in the area was from small wells which were liable to dry up during the dry season. In any event they could not be expected to support the squadron's silicol plants, and it was decided to site these near the irrigation tank at Andan-Kulam. It was now necessary to inflate all balloons after the initial inflation at this point and transport them to sites by road. All round the inner harbour, except the Inner Harbour Road and Naval Yard, the jungle reached the sea. The road round the harbour was very narrow and overhung by trees. The transportation of inflated balloons to sites was rendered very difficult and the chances of balloons being ripped in the process were considerable. However, these obstacles were surmounted and the squadron was operating twenty-seven balloons by the middle of May.

The personnel quickly settled down to ballooning under these new conditions, although in the early months of occupation the incidence of sickness rose to 20 per cent of the unit's strength. Chief complaints were Dengue fever, malaria, ulcers and tropical sores. Nevertheless morale remained extremely high.

In common with most balloon units operating in new localities overseas No. 990 Squadron was soon to find the weather capricious. At 1600 hours on the 3rd April, just two days after the initial flight, an electrical storm arose suddenly and destroyed three balloons. Similar storms arose at approximately the same time on each of the next five days, causing part of the barrage to be destroyed. A peculiarity of these casualties was that many times the lightning struck the cable causing it to melt, thereby allowing the balloon to break-away.

Barrage control at this time was very difficult. The Squadron was equipped with sufficient portable radio-telegraphy sets to provide one at each site, but these had not been unloaded from the ship. Communication between the Barrage Control Officer and sites was made by means of dispatch riders. When the sets

/were installed

were installed the barrage was very efficiently controlled and losses were reduced to infinitesimal numbers.

A few days after the initial appearance of the barrage a heavy Japanese air attack was launched against the harbour, and the aerodrome at China Bay. The raid was carried out by 66 bombers flying at 15,000 ft. and by 40 fighters which made a low-level attack, using cannon and machine-guns, on the aerodrome. Much of the balloon squadron's equipment, which was stored at the aerodrome, was destroyed or damaged. In addition three airmen were killed and one injured.

Although the barrage was not at full strength no attempt was made to attack the Naval Yard from a low-level. Only one aircraft was seen to penetrate the barrage and this is believed to have struck the cable of the balloon flying from No. 24 site. Final results of this collision were not observed and no claim was made.

In May 1942 the Commander-in-Chief, Ceylon, reviewed the balloon barrage policy concerning the island. As a result a new order of priority was decided upon as follows:-

(i) Colombo Harbour and Merchant Shipping.

(ii) Oil Tank Installation, and Ammunition Depot at China Bay.

(iii) Talisimanaar Ferry (Ceylon to India) Service.

The full programme would stretch the resources of No. 990 Squadron far beyond its intended establishment and doubts as to its ability to maintain all the barrages were expressed by the Squadron Commander. It was ultimately decided that the squadron would provide the two static barrages only. The target date fixed for the Colombo Barrage was the 15th June, 1942.

"A" and "C" Flights were transferred to Colombo and deployed; "A" Flight in the Fort area and "C" Flight at the north-east side of the Harbour. It was also arranged to fly waterborne balloons from ships as available. "B" Flight was redeployed at China Bay to cover the Oil Tank Installations and Ammunition Depot. The Colombo Barrage was raised for the first time on the 23rd June, sixteen balloons flying over the target. Two days later the reorganised barrage at China Bay made its initial flight.

The operational policy at China Bay remained as hitherto. At Colombo it was intended to fly day and night within the categories:-

State of Readiness "A" (additional risks to be taken and the maximum number of balloons to be flown in spite of bad weather).	When there are ships of the Fleet, valuable merchant ships, or auxiliaries in port and there is imminent threat of air attack.
State of Readiness "B"	When there are ships of the Fleet, valuable merchant ships, or auxiliaries in port but no threat of attack.

The strength of the barrage would, of course, vary according to the number of ships available for waterborne balloons.

/Operational

Operational control was vested in the Sector Operations Commander but it was arranged that the barrage would always fly on warning of air raids. In spite of the policy to fly at all times the balloons were close-hauled or bedded for long periods due to unfavourable weather and operational controls.

No. 990 Sqdn. Form 540

The China Bay Barrage, consisting of one flight, was found to be inadequate. On the 5th August, 1943, "B" Flight was ordered to rejoin the main body of No. 990 Squadron at Colombo, its commitment being taken over by No. 984 Squadron which raised the barrage to full squadron strength.

On the 29th July, 1944, instructions to deflate the Colombo balloons were received, and the barrage became non-operational two days later. At China Bay the barrage continued to operate until the 22nd November, 1944, when it too was deflated and the squadron disbanded.

A feature of the operations in Ceylon was the extraordinary long life of the balloons. It will be appreciated that the barrages were not in operation so frequently as in the Middle East. Even so, the fact that a number of balloons were in use for periods considerably in excess of one year, and in some cases in excess of 500 days, is worthy of special mention.

(b) Calcutta

The Japanese advance into Burma had brought Calcutta within easy striking distance of the enemy's land-based aircraft, and made the provision of balloon protection for the port a matter of the greatest urgency. It was therefore decided to deploy the next balloon squadron to arrive in India to that area. In March, 1942, No. 978 Squadron - the first unit of No. 274 (Balloon) Wing intended for the Persian Gulf - arrived in Bombay. It had an initial establishment of 45 Mark VI Balloons which were to be sited in the dock area of Calcutta and along the west bank of the Hooghly River from the Bengal-Nagpur Railway Jetty to a point opposite King George Dock. A number of "Nomad" balloons in groups of two or three - whose location would vary each night - were ordered to be flown in the town area. In addition, up to ten balloons were to be available to operate from ships in Diamond Harbour.

274W/S.201/1/ Org. Enc. 13A 20.4.42.

Balloons would be staggered at heights between 2,000 and 3,000 ft. To reach this maximum height it would be necessary to fly balloons in tandem, and instructions were given to fly such balloons from twelve sites. Operational control was vested in Headquarters, 224 Group, to be delegated to fighter formations at the discretion of the Air Officer Commanding that Group.

Although the whole of No. 274 Wing was diverted to India, it would appear that no action was taken to divert the ships carrying its equipment. Consequently considerable delay in providing the barrages resulted. The personnel of No. 978 Squadron disembarked during the first week of March and spent the next six weeks in the transit camp at Deolali. They did not arrive at Calcutta until 24th April, when they were installed in their sites without further delay. A few balloons were obtained and flown for training purposes but not until the 11th June, 1942, did the first operational balloon make its appearance. This was taken up river and flown over the Howrah Bridge. On the 16th June fifteen balloons appeared over the barrage area, but two days later, Headquarters, 224 Group, ordered the balloons to remain bedded until further notice.

No. 978 Sqdn. Form 540

/The proximity

The proximity of the balloon barrage to Alipore Aerodrome resulted in operational control over all balloons within 1½ miles of the flying field being given to the Station Commander, Alipore. At the same time No. 978 Squadron was given permission to operate a barrage of twenty-one balloons. The deployment of the full barrage was completed on the 4th July, and on the 26th July forty-six balloons were operational. Thirty-six of these were land-sited and ten waterborne.

Shortly after becoming fully operational the Squadron was ordered to earmark a complete flight for duty as a mobile unit. This eventually proceeded to Chittagong; the personnel being replaced by Indians.

Unfavourable weather and operational controls resulted in the balloons being grounded, or flown at heights not exceeding 300 feet for long periods. Indeed a total flying time of 168 hours for was deemed worthy of special mention in the Squadron Operations Book.

On at least two occasions the barrage was not permitted to operate during enemy air attacks on the area. The first of these was on the 20th December, 1942, when according to the squadron's report:-

> "At 2220 hours the sirens sounded the Air Raid warning. On instructions from Fighter Operations Room the barrage remained dull. At approximately 0245 hours, five bombs were dropped in Kidderpore Dock.... It was reported that several coolies were killed and a few civilians injured."

On the second occasion the report - also taken from the Squadrons Operations Book - showed that at 1120 hours on the 5th December, 1943, a yellow warning was received upon which the Howrah Barrage was raised to 2,000 ft. This was followed by an Air Raid warning at 1130 hours; the:-

> "Alipore Barrage was raised to 300 ft. at 1131 hours. The first bombs were dropped at 1147 hours. The second load at 1225 hours. The first attack consisted of 22 bombers flying at 15,000 feet...the second attack was made by eight bombers at the same height."

In all nine anti-personnel, and two 500-lb bombs were dropped in the unit area, killing two airmen and causing much damage to the squadron buildings and equipment. Although it may be argued that the raid was carried out at a height far beyond the maximum height to which the balloons could operate, the barrage was at no time in a position to counteract a change of tactics on the enemy's part.

No further enemy air activity was recorded after this last raid, but the barrage continued to be maintained in a state of "readiness" until the 5th February, 1945, when orders were received from Air Command, South East Asia, to become non-operational. The squadron was finally disbanded in India on the 31st March, 1945.

In view of the small amount of flying that was possible and considering the ineffective state of the barrage when enemy air attacks were made, it is doubtful if the maintenance of the barrage over three years was really justified.

(c) Jamshedpur

(c) Jamshedpur

274W/S906/E Enc. 14A 28.4.42.

No. 979 Squadron, the second balloon squadron originally intended for the Persian Gulf, arrived in India during April, 1942, and was despatched to Hamshedpur, to provide balloon protection over Messrs. Tata's Iron and Steel Works.

The squadron's arrival during the hot season resulted in many heat casualties among all ranks.

No. 979 Sqdn. Form 540

Forty-five sites were selected and prepared for operations but at no time were all these occupied. As with the Calcutta Barrage, lack of equipment considerably delayed full operations. However, a few balloons were obtained and flown to train the crews. No operational difficulties appear to have been encountered, either in deployment, hydrogen production or balloon repair facilities.

With the arrival of its equipment, the squadron speedily became operational. On the 20th July, the initial operations flight was made, fifteen balloons being raised to a maximum operational height of 2,000 feet. By the 2nd August, a barrage of forty-two balloons was operational. The barrage was subjected to the usual safety controls. These, and the unfavourable weather, considerably interfered with operations. Balloon casualties were very high, due to porosity and loss of purity; many balloons were also lost through lightning. Apart from this, the barrage had an uneventful existence and was eventually made non-operational on the 1st August, 1944.

The squadron personnel left Jamshedpur on the 31st August for Cocanada, where an intensive course of training in connection with combined operations was undertaken. This lasted until mid-November when the squadron returned to its former location. Balloon operations, however, were not re-started and the squadron remained inoperative until March 1945 when it was disbanded.

(d) Chittagong

No. 978 Sqdn. Form 540

Following severe enemy air attacks on the harbour and docks area, it was decided to deploy a rover flight to Chittagong. No. 978 Squadron was detailed to provide personnel for the task and on the 13th November, 1942, the main party consisting of 1 Officer, 80 B.O.Rs, 12 I.O.Rs. and 14 Enrolled Followers, left Calcutta. An advance party, consisting of 1 Officer and 6 B.O.Rs. had left two days previously to prepare for the arrival of the main body.

The flight arrived at Chittagong on the 16th November, and crews were deployed to sites on the following day. Balloons were deployed in the docks area and on the aerodrome, but no inflations were made until the 11th December, when, following enemy air activity against the docks on the 4th and 10th December, Air Headquarters, Bengal, issued instructions to fly from seven dock sites. The policy was to fly the barrage continuously at staggered heights, using both single and tandem balloons.

On the 15th December, the enemy made a machine-gun and bomb attack against the aerodrome during which two balloon operators were wounded. Bombs were also dropped on the docks area, one striking a billet used by Indian airmen of the unit. That same day, in accordance with instructions issued by Air Headquarters, Bengal, on the 13th December, all balloons deployed at the aerodrome were moved to the docks area and made operational.

/The following

The following day saw another air attack on the same area, but now the full barrage was operational, and although bombs fell in the dock area, all fell wide of the targets. The enemy aircraft also attacked the balloons, fourteen becoming casualties. All balloon casualties were replaced and a complete barrage was again operational on the 18th December, 1942.

Several warnings of impending air raids were received during the next few days, but no attack developed until 0008 hours on the 24th December, when six bombs were dropped in the protected area. At 0350 hours on the 28th December another attack was made, during which incendiary and high explosive bombs were dropped. The enemy's attacks continued throughout January 1943, culminating in an attack launched just after midday on the 23rd of the month. Fourteen enemy bombers approached from the east at 15,000 feet, and dropped many incendiary and high explosive bombs over the whole target area. Many fires were started and considerable damage was done. An ammunition barge in the docks caught fire. The flight inflation shed was wrecked and 13 balloons destroyed. Other Air Force buildings were hit and equipment lost and damaged. One balloon operator was killed and several airmen injured. In spite of the damage and loss of equipment, the barrage was again fully operational by the following afternoon.

In February, four additional balloons were deployed bringing the total flying in the barrage to twenty. On the 11th February, two officers and 48 airmen of No. 984 Squadron Rover Flight arrived. Part of this detachment was used to operate the additional balloons. Enemy air attacks diminished during February and March, but many warnings were received during late March and early April. From the middle of April until August the unfavourable weather conditions seriously interfered with balloon operations. Luckily the enemy appeared to have abandoned his attacks during this period, no doubt due to the same reason.

No. 987 Sqdn. Form 540

The fusion of Nos. 978 and 984 Squadron's Rover Flights into one squadron resulted in still more balloons being added to the barrage, and as No. 987 Squadron, the unit operated three flights at Chittagong until the 31st March, 1945. On this date, at 1004 hours, instructions were received from Headquarters, Air Command, South East Asia, to deflate all balloons and become non-operational. Within an hour these instructions had been carried into effect.

(e) Bombay

No. 984 Sqdn. Form 540

Balloons made their first appearance over Bombay on the 8th February, 1942, when the newly-arrived No. 984 Squadron raised a barrage of fifteen to the ruling operational height of 2,000 feet. This number was increased to thirty-eight by the end of December, thirty-two being flown from land sites and six waterborne. The number of waterborne sites depended upon the number of ships available in the harbour, and was never large due to the refusal of the Senior Naval Officer in Charge to allow balloons to be flown from ammunition ships.

An "Air Co-operation Control", which included within its compass all flying from Royal Air Force Station, Juhu, the Bombay Flying Club, and Tata Air Lines, was exercised by the 3rd Indian Anti-Aircraft Brigade. As communications between Barrage Control and balloon sites was very poor a daily list of control times was issued. To ensure an adequate margin

/of safety

of safety, the programme was arranged so that the barrage was close-hauled, one hour before the time of take-off of the first aircraft, until one hour after the last aircraft was due to land.

Weather conditions in November and December were favourable and balloons were flown almost daily during non-control hours. Deflations, for both loss of purity and porosity, were many and on at least two occasions during December balloons exploded whilst in flight. In January 1943, the weather deteriorated somewhat, causing operations to be severely curtailed.

Instructions to deflate the balloons and move to Assam were received from Air Headquarters, India, on the 7th January, and eight days later the barrage became non-operational. During its extremely short life in Bombay, no enemy air activity was encountered.

(f) Assam

No. 984 Sqdn. Form 540

No. 984 Squadron left Bombay on the 1st February, 1943; arrived at Digboi fourteen days later and was flying eight balloons in the new area by the end of the month. During March the barrage was increased to twenty-three balloons, but adverse weather seriously interfered with continuous operations.

In addition to the barrage at Digboi, a flight was deployed to Tinsukia, but at the urgent request of the Officer Commanding, United States Army Air Corps, in that area, it was immediately withdrawn. On the 17th March, operational control over the barrage at Digboi was vested in the United States Army Air Corps, Fighter Commander.

Due to continued bad weather and operational controls, the barrage was flown on very few occasions and was eventually deflated on 11th April, 1943.

SECTION 27

OPERATIONS - "CRITTALL" AND "SALAAM"

AHB/IID/34/4/32
~~KEW/S55369~~
Mins.29-32
10.1.42.

With the cancellation of the proposed balloon barrages for Eire, the necessity for holding, within Balloon Command, an organisation for the rapid deployment of balloons over an area likely to be subjected to attack was reviewed. As a result it was decided to retain a "Rover" squadron of forty balloons within No. 33 Group for deployment at short notice.

ibid. Enc.51B
6.5.42.

That the decision was justified was proved when a few weeks later there occurred what proved to be the first of a new series of enemy air attacks. The attacks were aimed at unprotected cities of no strategic importance but which were of great historical and cultural value to the nation. They marked the beginning of a new policy of reprisals by the German High Command for the heavy and sustained raids by Bomber Command on targets in Germany. Their purpose was to so undermine civilian morale that Bomber Command would be forced to effect a complete change in its bombing strategy. This was a vain hope as nothing could be allowed to interfere with our programme of systematic elimination of Germany's war potential.

Steps immediately taken to combat the new menace included the deployment of mobile balloon barrages and increased anti-aircraft gun batteries.

ibid. Enc.47A
5.5.42.

Mobile balloon squadrons raised within the existing resources of Balloon Command consisted of:-

3 Squadron Headquarters (One each by Nos. 30, 32 and 33 Groups)
7 Flights of ten balloons each (Two each by Nos. 30, 32 and 33 Groups and one by No. 34 Group).

Balloon Command would thus be in a position to call upon the nearest Group to provide a squadron in accordance with the size required and the location of the target to be protected. The mobile squadrons would be in a state of readiness to move immediately and complete deployment in any area within 48 hours. The organisation was to be such that, after deployment, the squadron might either:-

(a) Become established on a permanent basis,

(b) Return to its parent unit, should the emergency cease to exist, or

(c) Move to a further area to be protected.

The Attacks Commence

The German Air Force opened its offensive on the night of the 24/25th April, 1942, with a sharp raid by twenty-five aircraft against Exeter when over 26 tons of high explosive of a total of 52 tons fell in the target area. This was followed on the next night by an attack against the historic city of Bath, fifty enemy aircraft taking part. The night of the 26/27th April saw the attack repeated when sixty-five aircraft unloaded 65 tons of bombs on the area with a raid efficiency of 66.5%.

/The First Deployment

The First Deployment

DESTROYED KBC/35160 Enc. 1A 30.4.42.

Thereafter followed two raids on Norwich, both highly successful from the enemy's point of view, the raiding efficiency being 97.15% and 90.79%. This brought a loud and insistent demand for additional defences and Headquarters, Balloon Command, were instructed to provide a barrage immediately. No. 993 Squadron was selected for the task and ordered to be fully operational within 72 hours.

Owing to the extremely short notice given, the reconnaissance was carried out at the same time as deployment and naturally resulted in some confusion. Nevertheless the squadron was operational within the time allowed.

AUG/JD/34/4/42 KBC/35369 Enc. 49A 6.5.42.

The sequence of events that led up to the squadron being fully operational is worthy of mention:-

1630 hours 30 April.	Instructions to deploy received from Headquarters, Fighter Command and No. 33 Group ordered to despatch No. 933 Squadron.
1st May	O.C., Squadron and reconnaissance party arrived at Norwich, followed by signals unit from the Cardington Signals Post and part of main party. Partial reconnaissance carried out and signals arrangements made for barrage control.
2nd May	Reconnaissance and deployment to 35 sites completed. 26 balloons inflated and operational with effect from 2230 hours.
3rd May	Remainder of balloons inflated and squadron fully operational before noon.

The greatest difficulty was experienced in finding accommodation for the squadron headquarters as the Army were in occupation of all suitable premises. This naturally complicated the administration of the barrage.

DESTROYED KBC/35160 Enc. 9A 3.5.42.

Headquarters, No. 12 Group, were given operational control over the barrage, which was categorised as a second-line barrage, which necessitated balloons remaining close-hauled during the hours of darkness, except when the area was threatened with attack.

On completing the siting survey it was found that thirty-five balloons would provide all the protection necessary and it was decided that the remaining five balloons be held in reserve, to be deployed if and when the barrage commander deemed necessary.

Communication between squadron headquarters, flights and sites was made by wireless transmitter and receiver (18 Mk. III) an adequate number of replacement batteries being provided to ensure an unbroken watch being maintained. A direct telephone line between the Squadron operations room and that at No. 12 Fighter Group was installed. At three suitable points in the barrage, squeakers (1) were set up.

The question of gun control over the balloons was discussed with the commander of the 41st Anti-Aircraft Brigade, which had recently been considerably augmented. In view of the considerable communication difficulties involved it was decided to

/exercise

(1) See Section 29.

exercise no gun control unless it was found that the balloons interfered with gun-laying instruments, in which case the matter would be reconsidered.

Local safety control was sought by the Officer Commanding, Royal Air Force Station, Horsham St. Faith, over certain balloons sited in a direct line of approach to the aerodrome. These, it was claimed, interfered with the training of pupils in blind approach flying. It was agreed that these sites should be so controlled, and a field telephone line was laid between the two operations rooms.

KBC/F540
Appx.28/42.

The barrage had been operational for less than a week when, on the night of the 8/9th May, the enemy made another attack. The raid was on the same scale as its two forerunners, some thirty-five to forty aircraft taking part, but the results this time were vastly different. Only three bombs were reported to have fallen within the barrage area, the remainder, together with many incendiaries, fell in the neighbourhood of Stokes Holy Cross, to the south of the city, where a decoy site was situated. The raiding efficiency on this occasion was only 2.2% and the Squadron had the satisfaction of adding an enemy aircraft to Balloon Command's bag; for at 0129 hours a JU.88 struck the cable of the balloon at Site 33 and crashed at Stokes Holy Cross.

Possible Targets Surveyed

With an appreciation of the German Air Force's new tactics came the necessity to take action in an endeavour to counteract them. It was not possible to cover all likely targets prior to possible raids; to have done so would mean forming barrages in each area having a cathedral or historic building. The only possible procedure was to have likely targets surveyed so that deployment, when it was needed, could be carried out with all possible speed. This would at least prevent repeated low-level attacks and maintain civilian morale to a certain extent.

AHS/1D/34/4/32
~~KBC/S55369~~
Enc. 50A
8.5.42.

To this end, Headquarters, Balloon Command, issued instructions that certain reconnaissances should be carried out forthwith and the necessary data obtained and filed against sudden need. These surveys would be of a secret nature, and in order to maintain civilian morale, the reasons for the reconnaissance parties' visits would not be divulged. This would, of course, add to the difficulties of the surveys and might result in failure to obtain the best siting, but it was felt that any re-adjustment could be made after deployment. In any event, the result would be far better than another hurried reconnaissance, similar to that carried out at Norwich.

The areas selected were:-

No. 30 Group	Ipswich, Colchester, Canterbury, Winchester, Guildford.
No. 32 Group	Salisbury, Exeter, Bath.
No. 33 Group	York, Lincoln, Peterborough.

Groups were instructed to earmark suitable premises for squadrons and flight Headquarters, but no requisitioning action was to be taken. With all information available it was hoped that future deployments would be accomplished within 48 hours of the orders being issued.

/Exeter

Exeter

AHB/IID/34/4/18
~~KEW/8514684~~
Enc. 1A
9.5.42.

A second mobile squadron was ordered to deploy at Exeter, following an attack carried out on the night of 3/4th May, when 78 tons of bombs were dropped, 61.75 tons falling in the target area. The squadron consisted of two flights each of ten balloons, one of which, provided by No. 30 Group, was assembled fully equipped within five hours of the order to deploy being issued by Headquarters, Balloon Command. This flight became fully operational from dusk on the 11th May, 1942, and was followed by the second flight at dusk on the following day.

The barrage was deployed within a two mile radius of the centre of the city leaving a safety margin of four miles from the aerodrome. It was flown under normal barrage conditions. There followed a period of inactivity on the part of the enemy and the barrage was in consequence short-lived, being withdrawn on the 2nd June, 1942.

ibid. Min.5.

"Crittall"

AHB/IID/34/4/32
~~KEW/8553369~~
Enc. 61A
12.5.42.

On the 12th May 1942, Headquarters, Fighter Command issued Operational Instruction No. 20/1942, which outlined the action to be taken in the event of future deployments due to a recurrence of these vandal raids. The operation was given the code name "Crittall".

The two mobile barrages now operating were drawn from existing resources within Balloon Command and when formed, it was intended that they should fill a temporary need only, which when passed would allow the personnel and equipment to be returned to their parent units. As now, however, it was obvious that the "Baedeker" raids - as they had now become known - were likely to be a permanent feature of German Air Force policy, it was necessary to raise additional squadrons on an established basis. To this end the Air Ministry authorised an increase in the initial equipment of the L.-3 Barrage to cover the formation of three Mobile Squadrons of forty balloons each.

These were eventually stabilized within the following areas:-

ibid.
Enc. 74A
12.6.42.

(a) No. 10 (Fighter) Group - One Squadron to cover as required, EXETER, BATH, SWINDON, GLOUCESTER, ISLE OF WIGHT.

(b) No. 11 (Fighter) Group - One Squadron to cover as required, CANTERBURY, SALISBURY, WINCHESTER, GUILDFORD.

(c) No. 12 (Fighter) Group - One Squadron to cover as required, YORK, NORWICH, LINCOLN, PETERBOROUGH, IPSWICH, COLCHESTER.

The squadrons were numbered Nos. 992, 993 and 994 Squadrons.

'Salaam'

It was not intended to create additional squadrons for "Crittall" beyond those already authorized, but as it was impossible to anticipate the enemy attacks on any particular city it was evident that the barrages, would not - except by chance - be operational when the first attack was made. The purpose of the barrage was therefore mainly to assist the

/maintenance

maintenance of civilian morale after the initial attack and during subsequent attacks which usually followed closely on the first.

ibid. Enc.75A 17.6.42.

The removal of a barrage would quickly be apparent to German reconnaissance pilots, and the civil population would of course be aware of its disappearance immediately.

To create in the minds of both enemy aircrews and the general public the illusion that many more barrages were deployed than the three operating, Headquarters, Balloon Command, instructed Groups to form dummy balloon barrages supplementary to the mobile squadrons. When any mobile squadron was instructed to move, the squadron commander would select about 75 per cent of the sites and prepare them for the deployment of dummy balloons. The sites selected were those readily seen from the air and were usually situated on the perimeter of the barrage where balloons would show conspicuously against the surrounding fields. A few sites in busy areas where balloons could be seen by the local populace were also to be selected.

To keep the public unaware that a change in the barrage was being made the dummy balloons must be deployed as far as possible before the operational balloons were deflated. This, however, was not to prejudice the move of the mobile squadron to its new location within the specified time.

DESTROYED
~~KCB/51432~~
Enc. 5A
June 1942.

Six dummy barrages were authorized and were formed from the resources within the Group administering the mobile squadron at the time of its move. The establishment of each dummy barrage was:-

1 Flying Officer	2 Corporals
1 F/Sergeant	11 Aircraftmen (Balloon Operators)
1 Sergeant	

Two laying out and servicing parties and one inflation party (with petrol blowers)

1 Equipment Assistant
1 Medical Nursing Orderly
1 M.T. Mechanic.

Mechanical Transport consisted of:-

Motor Cycle	1
Combination	1
Tenders 3 tons	2
Vans 15 cwt.	1
Bicycles	6

At least 50 per cent of Balloon Operators, including N.C.O.s, had to be Drivers M.T., and in addition be able to ride motor-cycles.

The operation was called "Salaam" and was no doubt successful, to some extent, in foiling German aircrews, but not the general public. Inquisitive children the world over will quickly sense a new plaything if left unattended, so with the "Salaam Barrages"; the children seeing in every site a new playground complete with toy spoilt the effect as far as hoodwinking the local populace was concerned.

/Transport

Transport Difficulties of "Crittall"

A fundamental weakness in the rapid deployment of mobile squadrons to Norwich and Exeter had proved to be due to lack of transport. To overcome this it was decided that future deployments would take place in two parts, the main party with a reduced scale of general equipment, but sufficient to operate all sites efficiently would move in the first instance, followed by the rear party a day or two later. This decision greatly facilitated subsequent moves and coupled with the pre-reconnaissance policy resulted in very speedy deployments.

Canterbury

On the night of the 31st May, 1942, Canterbury was attacked by forty-eight enemy aircraft which dropped 55 tons of bombs, 83 per cent of which fell in the target area. Soon after mid-day on 1st June, Headquarters, No. 30 Group were ordered to deploy twenty L-Z balloons to the area immediately. No. 994 Rover Squadron was assembled and instructed to deploy over an area with a radius of roughly two miles from the centre of the city. The area had been subject to previous reconnaissance and deployment was effected with amazing speed, ten balloons becoming operational the same night, followed by the remainder at 0730 on the morning of the 2nd June.

AHB/ID/34/4/9
~~KBC/51687~~
Enc. 16A
June 1942.

Being a "rover" unit it was necessary for Headquarters, No. 30 Group, to contact all units holding crews ready for participation in its formation and issue movement instructions. The following extract of events leading to so successful a deployment may, therefore, be of interest:

1st June

11.05 hours	H.Q. Balloon Command notified H.Q. No. 30 Group that Rover Squadron could deploy.
11.10 hours	H.Q. No. 30 Group instructed all units of squadron to assemble at Nos. 3 and 4 Centres and R.A.F. Station, Chessington.
12.23 hours	Confirmation to deploy at Canterbury, received at H.Q. No. 30 Group.
13.50 hours	Movement order signalled to all assembly points.
14.15 hours	"A" Flight advance party left No. 4 Centre with hydrogen.
15.45 hours	"A" Flight left No. 4 Centre.
17.13 hours	"B" Flight left No. 4 Centre.
17.40 hours	Squadron H.Q. left R.A.F. Chessington.
21.10 hours	"A" Flight, less one winch (breakdown), arrived and commenced deployment.
21.20 hours	The first balloon inflated.
21.55 hours	Squadron H.Q. arrived.
22.45 hours	"B" Flight arrived and commenced to deploy.

/23.00 hours

23.00 hours — Direct Line from Squadron H.Q. to H.Q. No. 11 (Fighter) Group established.

23.59 hours — Nine balloons operational

2nd June

05.00 hours — Last crew installed on site.

07.24 hours — All balloons operational.

The speedy deployment of "A" Flight was to a large extent due to the assistance rendered by cadets of the local squadron of the Air Training Corps, who had been placed at the disposal of the squadron to guide individual crews to their sites. "B" Flight arrived too late to use the services of the cadets and were shown singly to their sites by the barrage commander. Enemy air activity did not hamper the deployment; eleven balloons were flying before the "all clear" sounded at 0409 hours.

The enemy launched a further attack against the city on the night of the 2/3rd June employing some 40 aircraft, but of the 23 tons of bombs unloaded only 8 tons fell within the target area. Commenting on the raids the Dean of Canterbury (Dr. Hewlett Johnson) in a letter to the Officer Commanding, No. 994 Squadron, said:-

ibid.
Enc. 18B
5.6.42.

> "I cannot adequately express our gratitude for what you have done for Canterbury City and Cathedral. The difference between the night of Sunday, May 31st and June 1st, and Tuesday, June 2nd, when your balloon barrage and augmented gunfire appeared on the scene was extraordinary. On Sunday night dive-bombing was incessant; on Tuesday I only noticed one dive-bombing attack, and that dive-bomber, carrying the heaviest load yet discharged upon us, probably a 2,000 kgm. bomb, was deflected into quite harmless ground. You have undoubtedly been one of the chief factors in saving Canterbury Cathedral."

Canterbury was again attacked on the night of the 6/7th June when fifteen enemy aircraft dropped some 40 tons of bombs, seven tons falling in the target area. There then followed a lull - the balloons nevertheless remaining deployed - until on the 31st October/1st November, the enemy resumed the attack with three sharp raids during which 76 tons of bombs fell, but again only 22 tons reached the target area. In all sixty-five bombers and thirty fighters were used in this raid, and direct hits were scored on military barracks outside the barrage area. This resulted in a request for four additional balloons, but although new sites were selected the expansion was not approved on the usual grounds of lack of equipment and personnel.

Salisbury

Following a month free from enemy air activity, the Exeter barrage was, on the 2nd June 1942, ordered to deploy at Salisbury. So far there had been no air attack on the city but it was reasonable to suppose that such a target as its ancient cathedral would not escape the enemy's attention for long.

/The barrage

AHB/IID/34/4/16
~~KBC/51632~~
Enc. 15A
2.6.42.

The barrage area had been reconnoitred and once again a speedy deployment of the barrage was made, in a rough circle with a radius of two miles from the centre of the city; Headquarters, No. 32 Group, reporting twenty-two balloons operational from 2230 hours on the 3rd June. Normal routine was carried out for the next two months but on the afternoon of the 11th August, a single enemy aircraft appeared unheralded over the city and caught the defences napping. It dived to 40 feet, dropped two bombs and machine-gunned the streets. On the afternoon of the 14th August, another single raider appeared without warning over the city, but on this occasion the barrage was flying at 5,000 ft. having been raised on receipt of a previous doubtful plot.

ibid. Enc.34A
17.8.42.

Two such raids within the space of three days caused the Royal Observer Corps to overhaul their warning system in that area. This brought to light a "blind-spot" which was immediately rectified. At the same time it was observed that the enemy had followed the lines of the River Avon and the railway to the target. To counteract this the barrage was thickened by three additional balloons which were operational from the 25th August.

Little damage was caused by these attacks which were not repeated and the barrage was ultimately withdrawn and transferred to Swindon on the 24th April, 1943.

Ipswich and Chelmsford

On the 12th September, 1942, Headquarters, Balloon Command, ordered the removal of the Norwich Barrage to Ipswich; the new barrage was expected to be operational within 72 hours. Here again, due to pre-reconnaissance, a speedy deployment was made and on the 14th September, Headquarters, No. 30 Group, were able to report 75 per cent of the barrage operational. In addition communications between the Operations Room at No. 11 (Fighter) Group and balloon sites had been established.

The barrage area was roughly circular and extended for two miles from the centre of the town. It was operated under normal barrage conditions and was subject to local safety controls by Royal Air Force Station, Martlesham Heath, and Ipswich Air Port - at that time used for training purposes. It was, however, short-lived and after only two months was transferred to Chelmsford and replaced by a "Salaam" unit.

AHB/IID/34/4/20
~~KBC/51927~~
Enc. 3A
2.11.42.

On arrival at Chelmsford, No. 993 Squadron was deployed over an area 2¼ miles diameter centred on the railway station. Its thirty-one balloons were operated as a first-line barrage and were operational from 2000 hours on the 14th November, 1942, just 48 hours after Headquarters, Balloon Command, issued its instructions. Communication with Headquarters, No. 11 (Fighter) Group was established through Royal Air Force Station, North Weald.

Enemy air activity against the city a few days after the barrage became operational revealed a weakness in the defence system, the enemy penetrating the barrage by flying in along the railway line. To counteract these tactics two balloons were re-sited.

The area was subjected to occasional light air attacks causing the barrage to remain until mid-1944, when the squadron was withdrawn to deploy with the "Diver" Barrage.

/York

York

That York would be high on the German Air Force's list of "Baedeker" targets was obvious from the commencement of these raids, and it was not long before the raiders paid a visit to the city. On the night of the 28/29th April 1942, forty enemy aircraft dropped a total of 83.85 tons of bombs 66% falling in the target area. A reconnaissance of the area was carried out in May, but it was not intended to deploy unless the attacks were repeated. The difficulty was the usual one, lack of equipment and personnel. Luckily the attacks were not repeated during the ensuing months and it was not until the end of October that a balloon barrage was deployed in the city.

AHB/IID/34/4/17.
~~KBO/51660~~
Enc. 1B
14.5.42.

From July, 1942, No. 985 Squadron had been standing by at Royal Air Force Station, Chessington, fully equipped to proceed overseas, but lack of shipping space had prevented any progress being made with its movement. No possible chance of shipping space being made available for the unit in the near future led the Air Ministry to suggest to both Fighter and Balloon Commands that some useful work should be found for it in the meantime.

The squadron was established to fly forty-five Mk. VI balloons and it was decided that a barrage of these at York would serve the dual purpose of protecting the city and enable the personnel to obtain valuable experience on the balloons to be operated overseas. A new pack-up was issued and the squadron deployed thirty balloons over an area 2¼ miles in diameter centred on York Minster.

Numerous difficulties in connection with supply were encountered and although the barrage was deployed in accordance with the previous reconnaissance, it was not operational until the 3rd November. Like most "Crittall" barrages it was designated a second-line barrage. Control was exercised by Headquarters, No. 12 (Fighter) Group with local safety controls granted to Royal Air Force Station, York, which was within 300 yards of the barrage and to Royal Air Force Station, Rufford, situated about two miles to the west.

ibid.
Enc.23A
5.11.42.

The former was a flying training unit and required the balloons close-hauled during most hours of daylight thereby effectively precluding any possibility of training by No. 985 Squadron. During the month of November the barrage was raised to 2,000 feet on only three occasions, but before any arrangement could be made to supplement this meagre training the squadron was ordered to proceed overseas. The barrage was deflated and became non-operational on the 3rd December after a life of just one month. Operation "Salaam" was not effected in this case.

Return to Norwich

AHB/IID/34/4/15
~~KBO/51640~~
Enc. 66A
18.11.42.

On the 28th November 1942, Headquarters, Fighter Command, ordered the barrage to re-deploy to Norwich. As previously a total of forty L-Z balloons was required. No. 993 Squadron was deployed at the time at Ipswich and a new squadron No. 995 was accordingly assembled and ordered to the area. The balloons were again operated as a first-line barrage under the operational control of Headquarters, No. 12 (Fighter) Group with the usual local safety controls.

/In May

In May a flight of twelve balloons was transferred to Yarmouth and was treated as an independent barrage under the operational control of No. 12 (Fighter) Group but remainded under the administrative control of the Squadron Headquarters at Norwich as a detached flight.

DESTROYED
~~KBS/52122~~
Enc. 11A
13.5.43.

On the 15th May the "Crittall" barrage, lately operating at Swindon, deployed to Lowestoft and was also treated as a detached flight of No. 993 Squadron. Of the eighteen balloons making up the establishment of the Swindon barrage only twelve were deployed at Lowestoft, the remaining six being used to augment the depleted Norwich barrage. The balloons were received enthusiastically by both the civil population and naval personnel in the town, and resulted in raising morale which had been considerably disturbed by the machine-gunning tactics of the enemy which had been a feature of recent air attacks.

ibid. Enc.28A
25.6.43.

On the 5th July 1943, No. 992 Squadron took over the control of the flights at Yarmouth and Lowestoft setting up Headquarters in the former town. The barrages, however, remained under the operational control of No. 995 Squadron at Norwich. This was a poor "set-up" and direct communication was sought with Headquarters, No. 12 (Fighter) Group.

ibid. Enc.30A
8.7.43.

Headquarters, No. 12 Group were alive to the difficulties of operating these coastal barrages and did not wish to impose an overriding control on the frequent occasions on which friendly aircraft flew over the area. To do so would be dangerous in an area where surprise attacks were likely. On the other hand to fly at ruling operational flight on the sounding of sirens would constitute an unnecessary danger to our aircraft in the vicinity, especially in view of the fact that the sirens in the neighbourhood were sounded on the instructions of the local Royal Observer Corps without reference to No. 12 Group.

To obviate difficulties, Headquarters, No. 30 Group, proposed that the Norwich, Yarmouth and Lowestoft barrages be limited to 1,500 feet unless the consent of the Balloon Officer at Headquarters, No. 12 Group, was obtained. On the approach of enemy aircraft near the area, balloons would be raised to the ruling operational height at the discretion of the Barrage Commander. Before, however, any decision was arrived at, No. 995 Squadron moved to Shoreham and Newhaven, being relieved at Norwich by No. 1 Mobile Flight. This resulted in control being passed to No. 992 Squadron.

Operational control was finally clarified by Headquarters, No. 12 Group, who in November 1943, issued its instructions to Headquarters, No. 30 Group. These, amended to suit changed barrage conditions in June 1944, were to the effect that the Norwich barrage would not be raised above 1500 feet either by day or night without the prior authority of the Balloon Officer, No. 12 (Fighter) Group, except on the approach of enemy aircraft when they would operate at ruling operational flight immediately.

The Yarmouth and Lowestoft barrages would be subject to a similar control except that they would be raised to ruling operational flight on the sounding of sirens by day. By night on the sounding of sirens, barrage control would first obtain the consent of the Balloon Officer at No. 12 Group before giving the order to fly balloons.

/Under the

AHB/IID/34/4/15
~~KBO/251610~~
Enc. 103A
19.6.44.

Under the reorganisation of Balloon Command, No. 1 Mobile Flight was disestablished and reformed as No. 951 Squadron. In this form it continued operations at Norwich until the 19th June 1944, when like many other barrages it was required to operate elsewhere.

Many areas in addition to those covered in this Section enjoyed "Crittall" protection for varying periods and for obvious reasons have not been specifically dealt with. Whether or not "Crittall" and "Salaam" justified their undoubtedly heavy cost depend entirely on one's attitude to the cultural aspect of life in this country. That these barrages did in large measure nullify the spoilation efforts of the German Air Force cannot be doubted.

/SECTION 28

SECTION 28

FURTHER RE-ORGANISATION IN BALLOON COMMAND

Examination of Establishment

Balloon Command Form 540 3.10.42.

In October 1942, when its re-organisation was almost complete Balloon Command was instructed by the Air Council to make a close scrutiny of its establishments with the object of making still further economies in personnel. The Air Officer in Charge, Administration (Air Commodore A.W. Mylne) forwarded various suggestions to all branches of the Command by which savings could be effected. He stated that

> "The effect of so many apparently unpalatable savings can be overcome by a general direction from this Headquarters that a duplication of duties is permissible for all trades in accordance with local conditions." (1)

Appendix C. 15.10.42.

These proposals were discussed at a conference held at Headquarters, Balloon Command, on the 15th October. The Air Officer Commanding, Balloon Command, made it clear that, while Women's Auxiliary Air Force training was in progress and twin cable bomb training in the offing, (2) he did not consider it feasible to effect reductions by eliminating centres, and the

Appendix E 13.11.42.

discussion at this end and a further conference in November were confined to existing establishment details. A number of minor reductions were approved but few radical changes were accepted. Although Balloon Command were prepared to recommend reductions in Women's Auxiliary Air Force balloon crews and waterborne balloon crews, the Command Air Staff regarded with disfavour any reduction in Royal Air Force land crews, and no reduction in the establishment of officers in squadrons was entertained. It had shown a marked increase since the beginning of the war, but so had the demands of such branches as Education, Anti-Gas, Fire, Defence, Gardening, Salvage, etc., all of which extended their activities down to individual balloon sites. In general, the establishment reductions possible without further reductions in balloons were small and not likely to effect much economy in numbers of personnel.

Reduction by Forty Per Cent

Balloon Command F.540 20.12.42.

Efforts to economise in manpower by minor reductions in establishments were soon eclipsed by a much larger project. In December 1942, the Air Ministry requested Balloon Command to make arrangements to reduce its strength by forty per cent as part of a cut of 225,000 personnel throughout the Royal Air Force. This involved a reduction in personnel from some 50,000 to approximately 30,000 and a major re-organisation would be required to effect it and at the same time keep as many balloons flying as possible.

/In a paper

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(1) This, in effect, said "We must mis-employ tradesmen to save other tradesmen."

(2) See Section 15.

Air Council Memoranda AC2/43 2.1.43.

In a paper submitted to the Air Council, the Air Member for Supply and Organisation and the Air Member for Personnel put forward various methods by which the cut of 20,000 could be made. Pointing out that the Women's Auxiliary Air Force substitution policy then being enacted was expensive in personnel, as 12 women did the work of 9 men, three methods were suggested:-

(a) To retain separately manned sites and to reduce the numbers of both airmen and airwomen to accord with reduced operational requirements.

(b) To eliminate airwomen balloon operators together with allied ancillary establishments.

(c) To form mixed crews of airmen and airwomen.

To do away with airwomen balloon operators would cause political embarrassment and it would be difficult to make use of airwomen in other Royal Air Force trades. The formation of mixed crews would effect the biggest economy in personnel, but there were objections to this in view of the conditions under which balloon operators worked. The adoption of the first method was recommended and was accepted by the Air Council on the 5th January, 1943.

Air Council Meeting 1.43. 5.1.43.

In preparing its proposals in accordance with the decision of the Air Council, Balloon Command calculated that with an estimated strength of 29,243, it would be able to fly some 1,573 balloons of which 560 would be operated by Women's Auxiliary Air Force crews.

Balloon Command F.540 Appendix A. 9.2.43.

It was proposed to retain the existing administrative system of Balloon Command while effecting, within its structure, substantial economies. The flying strength would have to be cut down. This meant doing away with some barrages altogether and submitting others to drastic thinning. The re-organisation proposals were to be carried out in two phases, the first covering the majority of barrages. The second phase, affecting only certain barrages, was to take place when the first had been completed and the Command was in a position to estimate its remaining resources to decide whether the second phase, which affected vitally important barrages, would be essential to produce the required target. Certain general principles underlay the specific instructions issued to groups. The existing system of administrative responsibility was retained with equality between groups as far as was possible. At least one Royal Air Force flight should be maintained in squadrons where the Women's Auxiliary Air Force operated balloons. Barrages of 20 balloons were to be administered as single flight squadrons with combined squadron and flight headquarters. All prime mover winches were to be retained and the proportion of half mobile and half non-mobile winches would be consequently changed. Mobile squadrons were to be treated as normal units from the administrative point of view. Establishments were framed so that auxiliary airmen, who had not signed certificates of willingness to be posted from their units, could be absorbed. Re-organisation proposals involving the rearrangement of groups and the reduction of squadrons based on these principles were submitted to the Air Ministry and on securing approval were issued to groups on the 25th February.

/The first

ibid. Appendix G. 23.2.43.

The first phase of re-organisation covered all barrages except those at London, Plymouth, Falmouth and Yeovil. Plans for these barrages would be considered on completion of Phase I. Other barrages were divided into two categories:-

(a) Protective barrages where balloons were sited so as to give the maximum protection to certain vulnerable points.

(b) Token barrages where the number of balloons flown was less than that required for full protection. Here sites to be retained should be such as were most suitable from the administrative and signals standpoint.

A great deal of the re-organisation programme concerned the closing down of a certain number of sites in barrages. Groups were instructed to retain as far as possible sites which were already provided with full-scale Women's Auxiliary Air Force accommodation and also where audible lightning predictors were installed. Preference was also to be given to those sites where there was ample room for the tail guy mooring. Sites which presented operational difficulties or sanitary problems should be vacated especially if they were unsuitable for Women's Auxiliary Air Force or were required by other services. Vacated sites where rents were low or the cost of reinstatement might be high were not to be given up in case of future deployment.

The revision of establishment provided a new scale for barrage control which varied with the requirements of each barrage. A new establishment was issued for squadrons of twenty balloons where the two flights could be administered from one headquarters, retaining their individuality as flights, but controlled administratively from the squadron headquarters. Royal Air Force crews on land sites were reduced to 2 non-commissioned officers and 7 aircraftmen, and on waterborne sites to 2 non-commissioned officers and 6 aircraftmen. Women's Auxiliary Air Force crews were to consist of 1 sergeant, 1 corporal and 10 aircraftwomen.

In No. 30 Group, group headquarters was to remain at Royal Air Force Station, Chessington, and No. 4 Balloon Centre eliminated, the administration of squadrons, for which it was responsible, being transferred to No. 1 or No. 3 Balloon Centres. Reductions were to take place in No. 954 Squadron (Weybridge), No. 928 Squadron (Harwich), No. 956 Squadron (Langley), and No. 924/30 Squadron (Southampton) where balloons were to be sited to cover Eastleigh and Southampton docks at the expense of areas already heavily bombed or not containing vital targets. No. 932 and 933 Squadrons at Portsmouth were to be amalgamated with a reduced strength; No. 995 Squadron (Norwich) was to be transferred to No. 33 Group.

In No. 32 Group, No. 14 Balloon Centre was to be eliminated and the balloon repair services carried out there for the South Wales squadrons transferred to No. 11 Balloon Centre, the remaining services continuing until after the South Wales re-organisation was complete. When No. 965 Squadron (Port Talbot) ceased to exist, the sixteen balloons remaining there were to operate as a detached flight of No. 958 Squadron (Swansea). No. 953 Squadron (Cardiff-Barry), No. 966 (Newport), No. 912 (Brockworth), and No. 955 (Weston-super-Mare) were to be reduced. No. 927 Squadron (Bristol) and No. 935 Squadron (Filton) were to be amalgamated as one squadron, flying a

/reduced

reduced number of balloons with two flights operating at Filton. No. 32 Group was to assume control of No. 6 Balloon Centre and in conjunction with No. 33 Group was to arrange for the reduction of No. 918 Squadron (Derby) and No. 916/17 Squadron (Coventry), which was to become a token barrage only. The Birmingham barrage was to be reduced to a token barrage of two squadrons.

In No. 33 Group, Nos. 8 and 16 Balloon Centres were to be vacated, and barrages at Runcorn (No. 22/3 Squadron), Accrington (No. 963 Squadron), Barrow (No. 950 Squadron) withdrawn. Nos. 919 and 921 Squadrons, Liverpool, were to be re-organised as a single squadron flying a token barrage of sixty-five balloons, the outer Mersey barrage having already been removed. At Manchester, Nos. 925 and 926 Squadrons were to be amalgamated as a single squadron flying a token barrage of forty balloons. No. 949 Squadron (Crewe) and No. 942/3 Squadron (Hull) were to be reduced but the six balloons flown from drifters in the Humber, were to remain unaffected, and No. 939/40 Squadron (Sheffield) was to operate as a token barrage only.

No. 34 Group headquarters was to be eliminated and the squadrons which it administered were to pass to No. 33 Group. No. 18 Balloon Centre, (Glasgow) was to be vacated, and the Northern Ireland barrages, No. 920 Squadron (Londonderry) and No. 968 Squadron (Belfast) were to cease to exist. Reductions were also to take place at Billingham, Newcastle and in the Forth, while the barrage at Blyth and the Clyde barrage were to be removed.

Barrages were to be reduced in the following manner.

Phase I

Group	Barrage	Present Establishment	Reduction	New Establishment
30	Weybridge	24	4	20
	Langley	24	4	20
	Harwich	32	2	30
	Southampton	63	15	48
	Portsmouth	64	10	54
32	Bristol	88	23	65
	Port Talbot	20	4	16
	Newport	30	6	24
	Swansea	32	4	28
	Cardiff	48	6	42
	Brockworth	24	4	20
	Weston	24	4	20
33	Mersey	27	27 already withdrawn.	
	Accrington	24	24	-
	Barrow	24	24	-
	Runcorn	48	48	-
	Manchester	104	64	40
	Birmingham	157	73	84
	Coventry	54	24	30
	Sheffield	64	11	53
	Derby	30	10	20
	Crewe	30	10	20
	Liverpool	92	27	65
	Hull	60	10	50

/34 Clyde

Group	Barrage	Present Establishment	Reduction	New Establishment
34	Clyde	8	8	-
	Londonderry	40	40	-
	Belfast	32	32	-
	Blyth	8	8	-
	Glasgow	112	72	40
	Billingham	48	6	42
	Newcastle	72	9	63
	Forth	51	11	40

Phase II

These proposed reductions would not be decided upon until the completion of Phase I.

Group	Barrage	Present Establishment	Reduction	New Establishment
30	London	300	125	175
32	Yeovil	24	4	20
	Falmouth	24	4	20
	Plymouth	67	11	56

No reductions would take place in the following barrages:-

Group	Barrages	Present Establishment
30	Canterbury	24
	Dover	24
	Thames	25
	Chelmsford	31
	Norwich	40
32	Salisbury	25
	Mobile flight	18 (not deployed)
33	Humber	6
34	Scapa	81

ibid. 31/4/43. Re-organisation in the manner specified in the comprehensive instructions issued to groups continued throughout April 1943. Groups forwarded to Headquarters, Balloon Command, their proposals which, when approved, were forwarded to the Air Ministry together with the new establishments required for official sanction. The Air Ministry would approve the establishment and issue it when the re-organisation date, which depended on the completion of signals, was announced.

ibid. 27/4/43. The scale establishments permitted units to plan their new organisation without having to wait for the formal issue of the approved establishment. In May, the process was sufficiently far advanced to take stock of the position. It was found that with Phase I nearing completion, the desired figure of man-power had been attained without touching the barrages in London, Falmouth, Plymouth and Yeovil. In addition, while the withdrawals were in progress, twenty balloons had been deployed at Sunderland.

/Despite

Despite all this rearrangement of the Command, it was still possible, with an establishment of approximately 30,000 personnel, to fly 1,638 balloons, many more than were anticipated when the reorganisation commenced.

Appendix A
1/8/43.
AH8/11D/34/4/21(8)
~~S.51976/Ops.~~
Enc.24A.
8.6.43.

On the completion of this reorganisation the disposition of balloon barrages was as follows:-

No.30 Group	London	300
	Thames	20
	Dover	24
	Harwich	30
	Southampton	48
	Portsmouth	54
	Langley	20
	Canterbury	24 (mobile)
	Norwich	40 (mobile)
	Chelmsford	31 (mobile)
	Weybridge	20
No.32 Group	Bristol	65
	Brockworth	20
	Cardiff	42
	Falmouth	24
	Newport	24
	Port Talbot	16
	Plymouth	67
	Swansea	28
	Weston-super-Mare	20
	Yeovil	24
	Salisbury	25
	Mobile Flight (undeployed)	18
No.33 Group	Birmingham	84
	Coventry	30
	Crewe	20
	Derby	20
	Hull	56
	Liverpool	65
	Manchester	40
	Sheffield	53
	Sunderland	20
	Billingham	42
	Forth	40
	Glasgow	40
	Newcastle	63
	Scapa	81
		1,638

Disbandment of Balloon Training Unit

Balloon Command
Form 540
28.9.43.

Before this sweeping reorganisation was complete, the Air Ministry was already suggesting a further cut of 2,000 personnel in Balloon Command. No measures, however, were taken to effect this specific reduction because of the new commitments which Balloon Command undertook in connection with the invasion of Europe. It was, nevertheless, decided in September, 1943 to disband No.1 Balloon Training Unit in order to save manpower and because with the reduced strength of the Command and the cessation of Women's Auxiliary Air Force training, the activities of this unit were considerably curtailed. Also, in the autumn of 1943, the new commitments demanded a complete reorganisation of the training establishment.

/Accordingly

ibid. Appendix C. 8.11.43.

Accordingly on the 8th November, 1943, instructions were given for the disbandment of No.1 Balloon Training Unit; courses administered by the unit would come under the direct control of Headquarters, Balloon Command (Training Section) and new establishments for these courses were issued.

Preparations for Invasion

Balloon Command Form 540 6.10.43.

Appendix B 16.10.43.

In October 1943, the Air Ministry raised the question of the part Balloon Command would be required to play in the invasion of Europe. Balloon Command stated that men could be found for this purpose by further Women's Auxiliary Air Force substitution. After consultation with Balloon Command, the Air Officer Commanding-in-Chief, Fighter Command (Air Marshal Sir T. Leigh-Mallory) suggested to the Air Ministry that the time had come for a complete revision of policy with regard to balloon defences. Taking into account the current and expected scale of enemy attack and the balloon requirements for Operation "Overlord" - the invasion of the Continent - he considered that balloon barrages were no longer required north of a line Severn to the Wash and west of a line the Wash to the Forth, with the exception of barrages flying at Brockworth, Rosyth and Scapa. In the area where balloons were retained the mobile squadrons operating at Norwich, Great Yarmouth, Lowestoft, Chelmsford and Canterbury should be made static and accommodation provided to allow for occupation by the Women's Auxiliary Air Force if necessary. For the "Overlord" operation a certain force of Mark VI balloons would be required both for defending embarkation ports in England and beaches and disembarkation points on the continent. The Air Officer Commanding-in-Chief, Fighter Command, recommended that this force, on a mobile basis, should be deployed in areas from which barrages were to be removed for the purpose of training and also to provide some balloon protection for those areas. He asked for no further reduction in manpower in Balloon Command until the requirements for "Overlord" were known.

Appendix E 13.11.43.

Informed of the general requirements of "Overlord", Balloon Command was able to calculate how many men would be required and how they could be found by acting on the policy put forward by the Air Officer Commanding-in-Chief, Fighter Command. It was assumed that a total of 4,041 officers and airmen would be wanted for the "Overlord" operation. The plan may be summarised as follows:-

Operation	Balloons	Balloon Operators	Other Trades	Total	Officers	Total
(i) Home Ports	175	421	235	656	36	692
(ii) Beach Parties	210	476	-	476	14	490
(iii) Port Squadrons	180	437	295	732	38	770
(iv) Balloon Repair	-	-	60	60	-	60
(v) Temporary Organisation in rear areas.	-	51	1006	1057	81	1138
(vi) Admiralty requirement for manning Hards.	-	385	-	385	8	393
(vii) 2 Mark VI Sqdns. reserved for deployment overseas but not for "Overlord" Operation	90	306	168	474	24	498
Grand Total	655	2076	1764	3840	201	4041

Balloon Command proposed to supply the men required by the elimination of barrages in accordance with the recommendation of the Air Officer Commanding-in-Chief, Fighter Command. There were alternative schemes, however, as at that time 31 per cent of balloon sites were manned by the Women's Auxiliary Air Force. If the rear barrages were removed the proportion would fall to 21 per cent and some 8,825 Royal Air Force and Women's Auxiliary Air Force personnel would be released, but, if the original proportion was retained on the remaining balloon sites, a total of 8,348 personnel would be released. In either case it seemed possible to find sufficient men from existing resources for the "Overlord" operation, and also to release a certain number for other Air Force duties. As, however, Balloon Command personnel had had little experience with Mark VI balloons flying on land it was necessary to make arrangements for extensive training facilities.

ibid.
14.11.43.

Planning for the Curtain Barrage.

Balloon Command Form 540 12.12.43.

While these plans for Operation "Overlord" were under consideration, Balloon Command was faced with another and even greater responsibility. In December 1943, it was advised of the possibility of attacks on this country by pilotless aircraft and that the Air Marshal Commanding Air Defence of Great Britain (1) (Air Marshal Sir Roderic Hill) was considering the use of balloons to constitute a physical defence against this form of attack. The plan for the deployment of what was called the "Crossbow" or Curtain barrage was drawn up in December, 1943. Briefly, the intention was to deploy some 500 balloons south-east of London sited in such a manner as to fly in the path of pilotless aircraft approaching the London area. The necessary personnel and equipment for this purpose could only be obtained by drawing on existing static defences, and Headquarters, Air Defence of Great Britain, asked the Air Ministry to approve the elimination of barrages at Birmingham, Coventry, Derby, Manchester, Liverpool, Crewe, Sheffield, Glasgow, Swansea, Port Talbot, Cardiff, Barry, Newport and No.995 Mobile Squadron at present undeployed. Some of these squadrons, manned entirely by Royal Air Force personnel, would be moved into the new area when deployment was ordered.

ibid
21.12.43.

With regard to the manpower position, the Air Ministry had ordered a reduction from approximately 30,000 to 28,000 in the strength of Balloon Command, while the instruction to hold some 500 men for two Mark VI overseas squadrons had been cancelled. It was considered possible, nevertheless, to find the men necessary for both the Curtain and the "Overlord" operations. It had been previously calculated that the elimination of the rear barrages would provide either 8,825 or 8,348 personnel in accordance with the policy followed with regard to Women's Auxiliary Air Force substitution. Now it was estimated that the requirements for future operations would be as follows:-

	Officers	Balloon R.A.F.	Operators W.A.A.F.	Other Trades	Total
(i) "Overlord"	92	1002	-	504	1598
(ii) Temporary Administration prior to deployment of "Overlord"	81	51	-	1006	1138
(iii) Admiralty Hards.	8	420	-	-	428
(iv) 500 "Crossbow" balloons including balloon repair personnel, but excluding administrative personnel for temporary balloon centre	126	2361	-	1055	3542
Total	307	3834	-	2565	6706

(1) Formerly Headquarters, Fighter Command.

Thus, the necessary number of men would be obtained for both operations and a small number would be still available for other Air Force duties.

Reorganisation, 1944 - First Phase.

Balloon Command Form 540 Appendix B 22.1.44.

AHB/IID/34/4/25(A)
~~KBC/S2249/Ops.~~
Enc.26A. 17.1.44.

Another major reorganisation was necessary to make these projects possible and detailed instructions were issued for this purpose on the 22nd January 1944. These instructions recalled that new balloon protection was required at home and abroad by balloons manned by the Royal Air Force only, and that the scale of air attack now made barrages no longer essential in certain areas. These areas had now been defined as those north and west of a datum line, St. David's Head, Bletchley, Goole and Falkirk with the exception of Brockworth, Rosyth and Scapa. In view of these circumstances some barrages were being disbanded altogether and the personnel from them pooled with those remaining in the Command, were to be utilised for new commitments. A higher proportion of Women's Auxiliary Air Force would be employed in the remaining barrages. The reorganisation scheme affected nearly every unit in the Command. Besides those squadrons that were to be eliminated, others were to be rendered non-operational and reformed ready to deploy at short notice in other areas. Some units were to take over new temporary shore servicing stations at invasion ports and hards (1) and hydrogen plants located at strategic points in case of breakdown in hydrogen factories.

In accordance with these instructions mobile squadrons at Norwich, Yarmouth, Chelmsford and Canterbury were converted to static units. For "Overlord" operations, port balloon squadron headquarters, port balloon flights for overseas port protection and beach balloon units for protecting the landing beaches were to be formed, and also port balloon flights and squadrons of Mk.VI balloons for the protection of embarkation ports in this country. These formations consisting of eight port balloon squadron headquarters numbered 992 to 999 inclusive, twenty port balloon flights, Nos.50 to 56 beach balloon units, controlling in all 565 Mark VI balloons, were to be accommodated and trained under the supervision of No.6 Balloon Centre (Birmingham) on the sites and headquarters previously occupied by the Birmingham barrage. Barrages at Portsmouth and Southampton were to be reinforced. At the request of the United States Army the South Wales barrages at Newport, Cardiff and Swansea, slightly reduced in strength, were to remain in temporary deployment pending their being required for the curtain barrage. The establishment of No.10 Balloon Centre (Manchester) was cancelled and two new balloon centres intended to administer the Curtain barrage on deployment were to be formed there. At London, Billingham, Hull and Bristol a greater proportion of sites was to be taken over by the Women's Auxiliary Air Force to release men for other operations.

The main features of the reorganisation effected by these instructions may be summarised as follows:-

Squadron	No. of Balloons	Reorganisation	New Squadron Number
No.945/7 (Glasgow)	40	Non-operational. Reformed as 40 crew squadron.	945/7
No.925/6 (Manchester)	40	Non-operational. Reformed as 40 crew squadron	925/6

(1) Hards are slipways built for embarkation purposes.

Squadron	No.off Balloons	Reorganisation	New Squadron Number
919/23(Liverpool)	65	Non-operational. Reformed as 40 crew squadron.	916/23
939/40(Sheffield)	53	Eliminated	-
949 (Crewe)	20	Non-operational. Reformed as 20 crew squadron.	949
916/7(Coventry)	30	Eliminated.	-
918 (Derby)	20	Eliminated.	-
911/13( ) 914/15(Birmingham)	84	Reformed as 31 static balloon squadron at Chelmsford.	911/13/5
966 (Newport)	24	Reformed as 20 balloon squadron temporarily deployed at Newport.	966
953(Cardiff/ Barry)	42	Reformed as 40 Balloon squadron temporarily deployed at Cardiff.	953
958(Swansea/ Port Talbot).	44	Reformed as 40 Balloon squadron temporarily deployed at Swansea.	958
995 (Mobile)	40	Eliminated (2 sites added to No.951 Squadron, Norwich)	-
10 Centre	-	Establishment cancelled. Care and maintenance party established to form Nos.22 and 23 Balloon Centres.	-

The requirement for the Curtain barrage had now been fixed at 480 balloons. As it was proposed to arrange for one crew to operate two balloons, 240 crews were recruited in the following manner from barrages which were to be rendered non-operational or to be deployed on a temporary basis:-

No.945/7	(Glasgow)	40 crews.
916/23	(Liverpool)	40 crews.
925/6	(Manchester)	40 crews.
966	(Newport)	20 crews.
953	(Cardiff)	40 crews.
958	(Swansea)	40 crews.
949	(Crewe)	20 crews.

The squadrons were to remain in their original areas until the Curtain barrage came into being.

The mobile squadrons were converted to static units, No.1 Mobile Flight (Norwich) flying eighteen balloons was reformed as No.951 Squadron with twenty balloons; No.992 Squadron operating at Yarmouth and Lowestoft became No.969 Squadron; No.993 Squadron (Chelmsford) took over the title of the Birmingham squadrons becoming No.911/13/5 Squadron and No.994 Squadron, (Canterbury) was renamed No.960 Squadron. In order to increase the L-Z balloon protection of ports from which invasion operations would be launched, twelve extra balloons were to be flown at Southampton and six at Portsmouth; crews and equipment being drawn from other barrages.

/Following

Following the receipt of these instructions, barrages at Glasgow, Manchester, Liverpool and Crewe became non-operational, and the balloons were deflated. The squadrons were reorganised in preparation for the Curtain barrage and became fully mobile and ready to move at short notice. Balloons also ceased to fly at Coventry, Sheffield and Derby, and the squadrons that had been operating there were disbanded. Royal Air Force Station, Norton, Sheffield, was transferred to Maintenance Command and instructions were given to prepare the organisation needed for the temporary balloon centres which were to be located at Royal Air Force Stations, Gravesend and Biggin Hill. No.22 Balloon Centre moved to Biggin Hill on the 19th February, 1944, and No.23 Balloon Centre to Gravesend on the 16th February, 1944. These centres were to administer squadrons as follows:-

ibid. 3.3.44.

ibid. 26.1.44.

ibid. 15.2.44.

No.22 Balloon Centre (Biggin Hill)

No.945/7 Squadron
No.953 Squadron
No.958 Squadron

No.23 Balloon Centre (Gravesend)

No.966 Squadron
No.916/23 Squadron
No.925/6 Squadron
No.949 Squadron

For reasons of security the squadrons were not moved into their new deployment areas.

The Air Staff instructed Balloon Command to complete its administrative arrangements for the Curtain barrage by the 26th February, so that deployment after that date could be carried out within eighteen days. In South Wales the barrages continued to fly to protect American installations on the understanding that if the deployment of the Curtain barrage was ordered, the balloons would be deflated and the squadrons concerned moved into the Curtain area.

Following the completion of this reorganisation the flying strength of the Command was reduced by 400 balloons and the disposition of barrages was as follows:-

SD.155/287/44

No.30 Group

London	300
Thames	20
Dover	24
Harwich	30
Southampton	48
Portsmouth	54
Langley	20
Canterbury	24
Norwich	20
Chelmsford	31
Weybridge	20
Yarmouth and Lowestoft	25

No.32 Group

Bristol	65	Temporary deployment	
Brockworth	20	Cardiff	40
Falmouth	24	Newport	20
Plymouth	67	Swansea/ Port Talbot	40
Weston-super-Mare	20		
Yeovil	24		

/No.33 Group

No.33 Group

Billingham	42
Forth	40
Hull	56
Newcastle	63
Scapa	81
Sunderland	20
Total	1,238 balloons.

Reorganisation, 1944 - Second Phase.

Balloon Command Form 540 5.4.44.

By April 1944, the reorganisation plans outlined in the general orders issued in January were completed. Barrages had been removed, new units created and trained ready to participate in coming operations. It was now necessary for Balloon Command to make further plans for the deployment of the new units that were to be engaged on "Overlord" operations and provide for new circumstances that had developed as the invasion plans matured. In particular, what was known as the "Plumtree" system required an organisation that had not been previously envisaged. This inviting title had been given to the means by which beach balloon units operating overseas were supplied with inflated balloons embarked on craft leaving this country and, if required, picked off the craft on arrival like fruit from a tree. The main features of the second reorganisation plans were the deployment of the hards and shore servicing stations, the Mark VI port balloon squadrons and flights operating at home.

ibid. Appendix B.

Reorganisation instructions for the second phase were issued on the 5th April, 1944. The deployment of parties for Admiralty shore servicing stations and hards was to be completed by the 20th April, and by the same date advance parties of the home port balloon squadrons and flights, comprising Nos.997, 998 and 999 Squadrons and Nos.118 and 119 Port Balloons Flights, were to be moved into their operational areas. Port balloon squadrons destined for overseas service were to remain at No.6 Balloon Centre from where they would proceed to a port of embarkation. A further beach balloon unit, No.57 Flight, was to be formed at No.6 Balloon Centre. This flight with No.56 Beach Balloon Unit, administered by a new small squadron headquarters (No.991) was intended for the protection of Mulberry "B", and was provided at the request of 2nd Tactical Air Force.

The organisation needed to work the "Plumtree" system was set up by Balloon Command under the name of Balloon Port Liaison Organisation. Its Officers were to ensure that the shore servicing station and hard parties were in possession of the necessary equipment and knew where and when the balloons were to be embarked. It was to operate in conjunction with the existing shore servicing station organisations, (1) which was a joint Admiralty and Balloon Command commitment operationally supervised by the Royal Navy.

Among the other instructions issued were details of changes in the composition and location of the hard parties and in the arrangements about the numerous shore servicing stations. The functions of No.6 Balloon Centre were defined. With the training of the Mark VI squadrons nearing completion, it was to continue to prepare and modify Mark VI balloons and equipment, undertake a proportion of the balloon repairs for the Curtain barrage and act as parent unit to Nos.992 - 996 Squadrons while they remained in the United Kingdom.

/No.951

(1) See Section 14.

No.951 Squadron at Norwich was to be prepared to deflate and join other squadrons in the Curtain area when deployment was ordered. The additional eighteen balloons at Portsmouth and Southampton were to be ready for flying within 48 hours after the 20th April, 1944. These balloons would be withdrawn from the Scapa barrage which was to be reduced as from the 15th April, 1944, from eighty-one to forty-six balloons, operating in four flights.

ibid. Appendix F. 14.4.44. ibid. Appendix F.1. 16.4.44. ibid. 24.4.44.

Headquarters, Balloon Command, issued instructions that Nos.103 and 104 Port Balloon Flights were to be prepared for embarkation and deployment as independent flights of fifteen and twenty-five Mark VI balloons each on the 16th April. Nos.974, 976 and 980 Beach Balloon Squadrons, which had been formed from Nos.50 - 55 Beach Balloon Flights, were transferred to 2nd Tactical Air Force and the newly formed No.991 Beach Balloon Squadron with its associated flights followed a few days later.

ibid. Appendix H. 25.4.44.

By the 25th April, all home port balloon squadrons were deployed in the areas which they were to defend. The disposition of these squadrons was as follows:-

No.997 Port Squadron

Weymouth	No.111 Port Flight.	20	Mark VI Balloons
Poole	No.112 " "	15	" " "
Portland	No.113 " "	10	" " "

No.998 Port Squadron

Newhaven	No.114 Port Flight	25	Mark VI Balloons
Shoreham	No.115 " "	20	" " "

No.999 Port Squadron

Torquay	No.116 Port Flight	20	Mark VI Balloons
Brixham	No.117 " "	15	" " "

Port balloon flights were attached to parent units as follows:

No.924/30 Squadron

Lepe, Stanswood Bay — No.119 Port Flight. 20 Mark VI Balloons

No.959 Squadron

Fowey — No.118 Port Flight 20 Mark VI Balloons.

In addition, twelve L-Z balloons had been added to the Southampton barrage and six to the Portsmouth barrage.

At the beginning of May, the port balloon squadrons intended for overseas (comprising Nos.992,993,994 and 995) were dis-established and reorganised as follows:-

No.992 Port Balloon Squadron administering -

No.101 Port Balloon Flight	25	Mark VI Balloons
No.102 Port Balloon Flight	25	Mark VI Balloons

No.994 Port Balloon Squadron administering:-

No.105 Port Balloon Flight	25	Mark VI Balloons
No.106 Port Balloon Flight	20	Mark VI Balloons.

/Nos.108

Nos.108 (15 Mark VI Balloons) and 120 (10 Mark VI balloons) Port Balloon Flights were re-established to operate as individual flights. These units with No.996 Port Balloon Squadron, including Nos.109 and 110 Flights, were transferred to No.85 Group on the 10th May, 1944.

ibid.
28.5.44

With the transfer of these trained detachments, the deployment of the home port squadrons and the completion of arrangements for the balloon port liaison organisation, the hard parties and shore servicing stations, Balloon Command had completed its preparations for the invasion of Europe and the advent of the Flying Bomb.

/SECTION 29.

SECTION 29

COLLISIONS - AIRCRAFT AND BALLOON CABLES

It was realised from the outbreak of war that the balloon barrage constituted a menace to friendly aircraft flying in poor visibility over areas not well-known to pilots. Obviously it was necessary for steps to be taken to prevent large numbers of our own aircraft becoming victims of the measures designed to trap the enemy. To this end, pilots were made acquainted with the exact positions of the various barrages likely to be encountered on their courses and were ordered not to fly in or near those areas. Flying in balloon areas was prohibited at all times unless prior authority had been obtained, the only exception being when our own fighter aircraft were in pursuit of the enemy. Nor was it permitted to fly over the barrage, irrespective of whether the balloons were flying or wounded. Despite the clarity of the instructions, many infrigements occurred and collisions were frequent, in many cases with fatal results.

S.4449
Encl.104B.

It was five days after the declaration of war and eight days after the barrage was first flown that the first collision occurred. On the 8th September 1939, at Southampton, a flight of three Swordfish flew through the barrage at 2,500 feet (the balloons at the time were flying at 5,000 feet), the port wing of the starboard aircraft striking and severing a balloon cable. The aircraft was thrown completely over and dived 500 feet, but fortunately regained height and was able to continue its flight. On reaching its base, examination showed that the leading edge of the lower mainplane was cut to a depth of fourteen inches, while the upper mainplane was damaged to a lesser extent.

On the 20th June, 1940, the first enemy aircraft collided with a balloon cable and crashed, but this was not before eleven of our own aircraft, five of which crashed with fatal casualties, had struck balloon cables.

Measures adopted to prevent Accidents

ibid. Encl.17A
13.6.40.

As a result of a meeting between Air Officers Commanding-in-Chief and the Director of Home Operations, the Air Ministry agreed to allow the barrages, east of a line London and Thames Estuary (exclusive), Lincoln - York - Newcastle (inclusive) as far north as the Tyne to be close-hauled on nights when bombers were returning from sorties, the times to be arranged by the

ibid. Encl.18A

Commands concerned. The barrages concerned were Harwich - Humber - Tyne - Tees and Blyth. The operational order also affected all waterborne balloons which were to be hauled-down to 1,000 feet during blackout hours. Bomber Command agreed to inform Fighter Command fifteen minutes after sunset of the barrages they required to be close-hauled. All balloons would return to local operational height on the cessation of the

ibid. Encl.19A
16.6.40.

official blackout. A suggestion was put forward by Fighter Command that the firing of rockets at one or two minute intervals in the vicinity of East Coast barrages as soon as it was known that our aircraft were returning would be helpful, but difficulties due to the slow communication between radar units and the proposed rocket sites were visualised and Fighter Command did not proceed with the idea.

ibid. Encl.24A
5.7.40.

The order to close-haul the East Coast barrages did not find favour with Fighter Command and in a letter to the Air Ministry, the Air Officer Commanding-in-Chief, Fighter Command stated that:-

> "... I consider that the close-hauling of balloons at a time when hostile aircraft are constantly operating in the areas concerned is undesirable, as the measure of defence provided by the balloons becomes non-effective ..."

/It was

It was also pointed out that in the case of waterborne sites, weather conditions might prevail which would prevent balloons being hauled down to 1,000 feet. The Commander-in-Chief added that a number of mobile flashing beacons (1) might be installed and suggested that this idea be considered by both Bomber and Balloon Commands.

ibid. Encl. 29A. 18.7.40.

This suggestion was adopted and for a short time a series of Balloon Marker Lights was installed. These had obvious disadvantages and were opposed by various civil authorities and private individuals who feared that unwelcome attention from enemy aircraft would result. Meanwhile at Harwich a special radio transmitter intended to warn friendly aircraft approaching the barrage area was being tried. Such transmitters were eventually supplied to all barrages and for a short time both marker lights and squeakers were used.

ibid. Encl.46A. 29.7.40.

Bomber Command's Concern

All these precautions, however, failed to arrest the mounting toll taken of friendly aircraft. In November 1940, Headquarters, Bomber Command again raised the question of its losses due to collisions with balloon cables. During the summer of 1940, twenty friendly bombers had collided with balloon cables resulting in the total loss of 10 aircraft and crews. It was emphasised that the collisions had occurred during a period of exceptionally good weather conditions and grave concern was felt that with winter conditions at hand the number of accidents would increase.

ibid. Encl.84A. 6.11.40.

The difficulties presented to pilots operating at night were mainly:-

(a) low cloud

(b) the regulations that aircraft must fly within sight of the ground unless cloud base was 1,000 ft. or lower.

It was clear that aircraft, flying in conditions where cloud base was between the stated minimum and the operational height of balloons, were likely to collide with cables. Aircraft leaving bases in East Anglia to attack targets in Western France were required to pass close to several barrages en route and it was pointed out that the slightest navigational error would result in infringements of the barrage areas. On the return journey the danger would be considerably increased. Two possible solutions were suggested:-

(a) Bomber aircraft should be given complete freedom to fly at any height over Great Britain

(b) Barrages likely to interfere with Bomber Command's operations on any particular night should be close-hauled.

Bomber Command fully appreciated the objections likely to be raised but favoured a return to the arrangements which were in operation before the introduction of marker lights.

As a direct result of this appeal the Air Ministry authorised Fighter Command, at the discretion of the Commander-in-Chief, to order the barrages to be close-hauled if requested to do so by Bomber Command. The bomber pilots would not be informed of the decision and would continue to take the usual precautions against infringements. Balloon marker lights would continue to operate.

ibid. Encl.89A 23.11.40.

/New Control Policy

(1) See page 496.

New Control Policy

The Air Officer Commanding-in-Chief, Fighter Command accepted the proposals and, in a letter to the Air Ministry, reviewed the barrage situation in the light of future operations.

ibid. Encl.90B. 12.12.40.

Barrages were placed in three categories, City, Country and Estuary.

(a) City barrages were those designed to protect large towns and vulnerable points surrounding a town.

(b) Country barrages were sited on land adjacent to vulnerable points other than those adjoining a town.

(c) Estuary barrages - waterborne balloons which might be part of a City or Country barrage.

When operational bomber groups required a barrage to be lowered contact would be made with Movement Liaison Section at Headquarters Fighter Command who would refer the request to the Duty Air Commodore. If enemy air operations did not require otherwise, he would authorise Headquarters, Balloon Command to issue the necessary orders. As soon as the need for close-hauling ceased, the Bomber Group concerned would notify Headquarters, Fighter Command who would arrange for the barrage to return to its operational height. Fighter Groups or Anti-Aircraft Command could make similar requests. At the same time, however, it was pointed out that City barrages were part of the defences of heavily defended zones liable to concentrated enemy air attack, into which areas our own aircraft were not likely to stray. In these circumstances the close-hauling of such barrages to facilitate the operations of Bomber Command should seldom be necessary or justified.

Estuary barrages which were mainly waterborne could not be operated speedily; therefore when weather forecasts indicated bad weather conditions for operational aircraft, Hull and Harwich barrages would be hauled down to 1,500 ft. under local arrangements. The control would operate from half-an-hour after sunset to half-an-hour before sunrise. Control would not be permitted during bright moon periods when it would be obvious to the enemy that the barrage was down.

Results of New Policy

Despite the precautions that had been taken, the worst fears of Bomber Command were realised and the rate of accidents increased with the winter months. Between the 1st September 1940 and the 22nd February 1941, no fewer than forty-three friendly aircraft struck balloon cables, in comparison to nine enemy aircraft; in addition numerous friendly aircraft had flown through the barrages without collision. During a period of four weeks nine friendly aircraft flew through or over the Crewe barrage alone, fortunately without any disastrous results.

ibid. Encl.111A 22.2.41.

Investigation revealed four probable reasons for such infringements:-

(1) Ignorance as to the whereabouts of barrages due to lack of knowledge of the contents of S.D.158(2)(1).

(2) Pilots on cross-country flights not attempting to keep a wide margin from barrages on their courses.

(3) Lost pilots being apt to follow a main railway line to a large town which could be recognised.(2)

/(4)

(1) Air Ministry Publication - Secret Routeing.

(2) Considered the main reason for the frequent infringements at Crewe.

(4) Carelessness or bravado.

The majority of incidents occurred during daylight hours and it was clear that Balloon Command, short of becoming non-operational, had taken every precaution to ensure the safety of aircraft and pilots. It was now the concern of the other Commands to take vigorous steps to see that pilots were properly briefed as to the whereabouts of barrages and to take disciplinary action in all cases of wilful infringement.

Suggestions put forward by the Director of Fighter Operations in a letter to the Commanders-in-Chief of Operational and Training Commands, included:-

(a) The provision of information rooms where maps clearly showing the balloon barrage areas could be displayed.

(b) Pilots to be taught to memorise balloon barrage positions from the beginning of their courses of training.

(c) Pilots to be impressed with the fact that a collision with a balloon cable would not only most likely destroy the aircraft and kill themselves and their crew, but would also constitute a danger to large numbers of civilians in their homes or on the streets.

Here, once again, the steps failed to show any appreciable effect.

Radio Warning Transmitters.

ibid. Encl.120A. 7.5.41.

In a report to the Air Ministry in May 1941, Headquarters, Fighter Command stated that during March and April, 1941, a total of twenty-eight friendly aircraft collided with balloon cables and a further ninety-four friendly aircraft flew over or through barrages without striking a cable. Again, by far the greater number of these incidents occurred during daylight and as all barrages had been in existence for some considerable time, ignorance could not be accepted as an excuse.

By the end of June 1941, Balloon Marker Lights, which had failed to achieve the desired end and in addition had been a source of irritation to local inhabitants, had been withdrawn and replaced by Squeakers, but just as Marker Lights were unpopular with civilians, so were Squeakers with the pilots, who complained that the aircraft inter-communication system was useless when near barrage areas. Curiously enough, when questioned after a collision the crews nearly always stated that no Squeakers had been heard, even though they were reported serviceable and in operation at the time.

ibid. Encl.126A 2.6.41.

On the 27th May 1941, a conference was held by the Air Officer Commanding No.2 Group, at which representatives from Nos.4 and 5 (Bomber) Groups, Anti-Aircraft Command and the Naval Authorities in the Humber area were present. The object of the conference was to consider what measures might be taken to prevent friendly aircraft entering the heavily gun-defended area of the Humber where great risks would be incurred from the anti-aircraft defences and from intensive fighter opposition during the moonlight periods. One of the main points arising from the discussion was the apparent ineffectiveness of Squeakers. It was pointed out that only seven friendly bombers passed over the Humber barrage in March, whereas in April, after the withdrawal of marker lights and the substitution of Squeakers, fifty-seven infringements occurred. In view of this fact the conference recommended a reversion to Balloon Marker Lights.

/Defence.

Defence of Squeakers

ibid. Encl.127A. 6.6.41.

The suggestion of a reversion to Marker Lights brought a sharp response from Balloon Command who pointed out that the preliminary tests of Squeakers had proved so successful that the Air Ministry had ordered provisioning action to cover this installation for all barrages. The first Squeaker was installed at Harwich on the 8th March and had operated continuously since then with very few breakdowns. Balloon Command quoted extracts from several reports received, one of which, received from No.44 Squadron through No.5 Group, stated:-

ibid. Encl.127B 6.6.41.

> "... It was apparent that the Squeakers are very effective, but the squeak is much too frequent and prevents all communication between the crew ..."

While this attack on Squeakers was proceeding, Coastal Command asked for their removal, as they interfered with the reception of ordinary signals traffic - another positive statement as to their effectiveness.

Whether the Air Ministry would have agreed to the restoration of Marker Lights is not known, but in June 1941, a document was found in a crashed German aircraft showing the disposition of the lights, which proved conclusively their aid to enemy navigation.

Disciplinary Action.

S.4449/2 Encl.1A 8.6.41.

As there was no diminution in the figures of infringements for May 1941 as compared with those for April, the Air Officer Commanding-in-Chief, Fighter Command, (Air Marshal Sir Sholto Douglas) in a letter to the Air Ministry, asked for consideration to be given to taking disciplinary action against the pilots involved in the more flagrant cases, especially in view of the fact that of the sixty-seven infringements reported, sixty-two had occurred during daylight. He said :-

> "...It is appreciated that inexperienced pilots find it difficult to navigate accurately in addition to other preoccupations. Such barrages as Hull - Harwich - London - Thames - Dover - Eastleigh - Southampton - Portsmouth and Plymouth, however, lie in areas which pupils should avoid by wide margins, yet these barrages accounted for one-third of the cases under review. Moreover, it is suggested that inexperience alone is not a completely satisfactory explanation, otherwise many more than these cases could have occurred at night ...."

He further urged that wider safety margins be given when routeing aircraft and also intensive propaganda circulated on the risks involved, especially as heavier cables were to be adapted to counter enemy "bumpers".

Marker Balloons

Whatever action was taken in regard to these proposals and indeed it is very doubtful whether any was taken at all, the position remained just as serious, as the report for June showed that there had been seventy-two infringements (the highest number yet), 92 per cent of which took place in daylight. While again urging that some action be taken to reduce the number of incidents, the Air Officer Commanding-in-Chief, Fighter Command proposed that the perimeter balloons of all land barrages should fly below cloud base, provided it was not less than 1,500 feet, thus acting as barrage markers to Allied pilots. This action it was hoped, would assist

/pilots

pilots who had lost their bearings, but the Air Ministry were asked not to communicate this decision to other authorities as it was not considered that pilots should be encouraged to rely upon such assistance, especially as at any time the balloons might be required to revert to full operational height. The proposal received approval, and was duly put into effect with, it can be assumed, a small measure of success, as the number of infringements fell during the following month to sixty-two. Nevertheless, the rate was still far too high for complacency.

ibid. Encl.21A 5.8.41.

Additional Instruction and Training of Pilots.

The Air Officer Commanding, Balloon Command (Air Marshal Sir Leslie Gossage) urged that more intensive instructions should be given to pilots during their period of training, covering lectures on balloons, arming of balloon cables and the effect of balloon armament on aircraft. This suggestion was considered by the Director of Flying Training with the result that Balloon Command was instructed to prepare a suitable short lecture to be incorporated in the training curriculum.

The number of infringements during August 1941, showed a further fall to forty-two but any satisfaction the Air Officer Commanding-in-Chief, Fighter Command may have felt was shortlived as the figures for September and October rose to fifty and sixty-three respectively.

Balloon Operational Policy Revision.

With the increasing momentum of our own air offensive, it became very obvious that drastic steps must be taken to prevent casualties due to collision mounting to astronomical heights. To this end, on the 13th October, 1941, Air Marshal Sir Leslie Gossage wrote to the Air Officer Commanding-in-Chief, Fighter Command proposing that the barrage remain grounded except when warning of attack was given. This was completely at variance with the policy obtaining hereto which required the barrage to fly at all times with the exception of short periods needed for maintenance.

AHB/IID/34/4/24
~~KBC/52073/Ops.~~
13.10.41.

In his letter Sir Leslie Gossage said -

> "As our offensive in the air increases and the number of fighters constantly operating becomes greater, considerably more limitations than at present will have to be placed on the operations of balloons. It is not my idea that balloons will lose their usefulness; they will always be required to meet the conditions that are unfavourable to fighter aircraft and A.A. guns. All the same as we know from the tale of reported collisions with balloon cables by friendly aircraft, balloons are becoming a menace of increasing seriousness to the latter and it has been my endeavour to find some means of steering a course between this danger which the balloons constitute and the continued maintenance of their usefulness".

The new policy was dependent on rapid communication between Fighter Control and individual sites, and after lengthy examination by Fighter Command a conference was called to discuss the points on which the two Commands were not in entire agreement.

/The

The conference was held on the 1st November 1941, the new policy being discussed under three aspects -

(a) Factors favouring its adoption

(b) Political, operational and technical difficulties

(c) Conclusion as to principle to be adopted and action to be taken.

The Air Officer Commanding-in-Chief, Fighter Command opened the discussion by saying that

..."having given Balloon Command's proposals careful consideration, I have come to the conclusion that they are only practical in part....."

His view was that the new principle of grounding or close-hauling balloons might be acceptable for inland barrages, but that coastal barrages ought to fly as continuously as possible In support of his view he instanced that:-

(i) Coastal barrages received little or no warning of the approach of low flying enemy aircraft and were therefore more liable to surprise attack.

(ii) The enemy would soon get to know if these coastal barrages were not being flown. This might induce him to recommence his attacks on fringe targets.

The Air Officer Commanding, Balloon Command, referring to the factors that favoured his policy, said that many barrages were subjected to such frequent control that they hardly flew at all. He pointed out that:-

(i) Many aerodromes, all given some degree of local safety control, were situated in or near barrages, which resulted in barrages being continuously grounded for considerable periods.

(ii) Permission had recently been given to Anti-Aircraft Command to increase considerably anti-aircraft co-operation for calibration and training purposes within or near barrage areas. This would further increase the periods when balloons were grounded.

(iii) The casualties to friendly aircraft occurring under existing conditions were considerable, especially by day.

These would be materially reduced under the new proposals.

Referring to the political, operational and technical difficulties, the Commander-in-Chief, said:-

"...The flown balloon is an appreciable factor in maintaining public morale and considerable political difficulty can be expected if barrages are continuously grounded.
As far as operational considerations are concerned, it is clear that with the existing facilities, twenty minutes would be required to fly to operational height. Coastal barrages cannot be given this warning....."

/He said

He said he would be prepared to recommend, in view of the reduced enemy air activity over this country, a policy of grounding or close-hauling of inland barrages which were 50 miles from the coast or sufficiently remotely situated to enable adequate warning to be given. In this connection, he considered that any scheme for grounding balloons must provide for sufficient flying to safeguard the training of the crews and to maintain the morale of the public.

Balloon Command considered that if barrages were normally flown at 500 feet the situation as regards morale and training would be overcome, but the Commander-in-Chief insisted on some flying to operational height.

For speed of transmission of operational orders, it was desirable to have Balloon Control Officers in Fighter Group operations rooms. Their duty would be to disseminate information of hostile plots by direct lines through Balloon Group Headquarters to Barrage Controls. Barrage Control would be guided by local weather conditions in giving effect to such orders.

It was finally decided that:-

(a) Coastal Barrages would fly normally day and night until improvements in communications and the warning system justified close-hauling or grounding, with the exception of Dover and Harwich which would always fly to operational height.

(b) Inland barrages would be grounded by day and night, but would be raised to operational heights on receipt of enemy plots.

(c) Barrages flown at reduced heights or grounded would be flown to maximum operational height twice weekly to ensure training of crews and public morale.

(d) Balloon Command would provide Control Officers at Fighter Groups and obtain improvements in communications.

Trials of New Policy.

ibid. Encl.24A 29.11.41.

Before submitting the proposals to the Air Ministry for approval, Balloon Command were asked to hold a full-scale trial with certain barrages in the South-West of England by linking No.32 (Balloon) Group to No.10(Fighter) Group. The barrages selected for the trial were Bristol - Avonmouth - Filton - Brockworth - Yeovil and Weston-super-Mare, all based on No.11 Balloon Centre. The trial period was for one month.

ibid. Encl.66A. 20.1.42.

On the 20th January 1942, the Air Officer Commanding, Balloon Command forwarded his report to Fighter Command; it showed that during the period under review only a few dangerous plots were recorded at Headquarters No.10 Group upon which balloons were flown to operational height. In view of the restricted enemy activity and in order to obtain further experience in the new system, two special exercises with dummy plots took place. In all cases the barrages, which had received 15 minutes warning, were at operational height by the time the dummy plot reached the barrage area, but in one case when only 10 minutes warning was given the Yeovil barrage had not completed the operation by the time the plot reached them.

/Communications

Communications were disappointing, speech on occasion being very indistinct which made it difficult for the Control Officers to convey their orders to certain barrages.

From the experience gained during the month it was concluded that:-

(i) Balloons at tail guy mooring could be raised the ruling operational height within fifteen minutes from the order to fly being given.

(ii) Bedded balloons required three to five minutes more warning, but as 60 per cent of the balloons had tail guy mooring a fairly effective barrage would be at ruling operational height by the time the first enemy aircraft appeared over the target area and the remainder would be well on the way to ruling operational height.

(iii) Communications needed improvement but the new system could be operated within those existing.

Having taken all the factors into consideration and assuming plots fifteen minutes from the barrage area could be relied upon, the Air Officer Commanding, Balloon Command stated -

..."I feel justified in recommending the adoption of the new policy throughout Balloon Command except in coastal areas. Even if the whole of the barrage is not at operational height by the time the first enemy aircraft arrives over the target, the greater proportion will be flying, and will afford the moral deterrent, and the remainder will be up very soon afterwards".

Adoption of New Policy

ibid. Encl.79A. 31.1.42.

The Air Officer Commanding-in-Chief, Fighter Command approved the results of the trials and notified the Air Ministry of his intention to operate all inland balloon barrages accordingly. Immediate steps were taken to link-up all barrages to the Fighter Groups concerned. At the same time No.82 Group was advised of the trials and their results, and asked to consider the operation of the Northern Ireland barrages on similar lines. No.82 Group, however, were definitely opposed to the suggestion and considered the time warning of enemy plots would not be sufficient to enable barrages to be raised to operational height. An alternative proposal, to fly at 1,500 feet except when enemy plots were received, was also not considered practicable.

AHB/IID/34/4/34
~~KBC/52073/Ops.~~
Encl.81A.
7.2.42.

The United Kingdom barrages were now controlled as follows:-

/Inland Barrages

Inland Barrages and Barrages Remote from Surprise Attack	Control and Date of Commencement	Coastal Barrages
	No.9 (Fighter) Group	
Birmingham Coventry Liverpool Barrow Runcorn Crewe Manchester Accrington	1200 hrs. 14th May, 1942	Liverpool (Outer Mersey)(1)
	No.10 (Fighter) Group	
Cardiff Liverpool Barry Swansea Port Talbot Brockworth Avonmouth Filton Bristol Weston-super-Mare Yeovil	1800 hrs. 15th March, 1942	Plymouth Falmouth
	No.11 (Fighter) Group	
London Weybridge Langley	0800 hrs. 17th April, 1942	Thames Dover(2) Harwich (2) Southampton and Eastleigh Portsmouth
	No.12 (Fighter) Group	
Glasgow	0800 hrs. 3rd. August, 1942	Newcastle Newcastle Mobile Barrage (3) Blyth Billingham Clyde(4) Firth
	No.82 (Fighter) Group	
-		Londonderry(5) Belfast Lisahally(5)
	Orkneys	
-		Scapa(6)

/The proposal

(1) Waterborne sites which cannot be close-hauled speedily will fly at ruling operational height.

(2) Dover and Harwich will be flown at full operational height whenever possible.

(3) Humber and Tyne Mobile Anti-Minelaying Barrages operate at night only and will fly at ruling operational height.

(4) Waterborne sites in barrage will fly at ruling operational height by day and night.

(5) Barrages in Northern Ireland will be operated at discretion of A.O.C., No.82 Group.

(6) Will continue to be operated at the discretion of Admiral Commanding, Orkneys and Shetlands.

S.4449
Encl.75A
15.3.42.

The proposal to fly the Plymouth barrage at 1,500 ft. drew a protest from the Naval Commander-in-Chief, Plymouth who considered that the policy would increase the risk of mine-laying and low-level bombing from lone raiders. Fighter Command agreed to treat the Plymouth barrage as a special case and ordered it to remain at ruling operational height by day and night.

Results

There can be no doubt that the new policy was a success. Although infringements greatly increased, the number of collisions became comparatively small. By August 1942, the control was complete, the infringement figure for that month being 245 of which only nine aircraft collided with cavles, two with fatal results.

ibid.
Encl.112A
13.9.42.

The increase in the total of infringements cannot be accounted for solely by the increase in our air strength. From the jump in the figures between May 1942(1) and the end of the year it was obvious that the policy of close-hauling barrages had leaked out and pilots were taking advantage of this new freedom of the air.

Anti-Aircraft Zones

Although the danger from balloon cables had more or less passed there still remained the danger of aircraft coming under the fire of our own anti-aircraft batteries.

All balloon barrages were the centre of heavily defended Anti-Aircraft Zones and to fly within these areas was forbidden. This being so, all anti-aircraft batteries, unless definite recognition had been made, could assume that any aircraft within the zone was unfriendly and open fire upon them. Had this rule been strictly adhered to no doubt infringements would have rapidly decreased, but the toll of friendly aircraft would have been enormous. Luckily Anti-Aircraft Command showed extremely good sense in not exercising this right unless enemy plots were shown.

Squeakers

S.5504
Encl.
14.6.40.

With the original policy of flying balloons continuously except when weather conditions made it impossible, it was inevitable that collisions between British aircraft, and balloon cables would occur sooner or later. In June 1940, Air Officer Commanding-in-Chief, Bomber Command (Air Marshal C.F.A. Portal) expressed grave concern over several incidents which involved bomber aircraft colliding with the cables of balloons flying in Great Britain. The Air Staff accordingly instructed Group Captain D.H. de Burgh of the Royal Aircraft Establishment, Farnborough, to consider, as a matter of urgency, ways and means of warning aircraft of the proximity of balloons. Various suggestions had been made, including coloured searchlight beams, ground mobile radio beacons, lights attached to the balloon cables, and other radio methods, and it was thought that the solution would lie in some radio apparatus which would have to be "something that is not too elaborate, and something easily, and above all quickly, fixed up".

/Group Captain

(1) May 1942 - 94 Infringements

Dec.1942 - 368 Infringements

ibid. Encl.2A 11.7.40.

Group Captain de Burgh lost no time in investigating this question, for on the 11th July, Bomber and Fighter Commands were informed not only that a solution had been found, but that the first model was ready for trial.

> "The apparatus consists of a small transmitter working into a 25' aerial. This can be erected at a convenient position in the balloon barrage area. The transmitter emits a note similar to that of an air raid siren, which will make itself audible in the inter-communicating system as fitted in bomber aircraft on the latter approaching within 8 miles of the transmitter site. The frequency band covered is 6.45 to 6.10 mc/s, i.e. that on which the type TR9 receivers installed in the majority of the operational aircraft of Bomber Command are set up. The characteristics of the transmission are such that there is an abrupt "cut-off" outside this frequency band".

ibid. Encl.4B. 29.7.40

ibid. Encl.4A. 8.8.40.

ibid. Min.5 6.5.40.

ibid. Encl.7A/ 13A. 17.8.40.

An experimental set was installed at Harwich, and trials carried out on the night of the 27th July from a Wellington aircraft at heights varying from 1500' to 4000 feet with very satisfactory results. It was established that the transmitter emitted a definite and unmistakeable note which came on abruptly anywhere within a radius of eight miles, and on the strength of this one brief test Bomber Command recommended that provision should be made for the manufacture of sufficient sets to enable all barrages to be equipped. While the question of the number to be ordered was under consideration, a further four sets were ordered from the Royal Aircraft Establishment incorporating certain improvements. At that time there were thirty-three barrages in being, and a further ten projected, but it was decided to order 100 sets for delivery as soon as possible as there had been further incidents involving collisions between friendly aircraft and balloon cables. By now Coastal Command was also interested, and it was arranged that one of the sets should be loaned them for trials on their radio frequency (6470) and that the other three should be handed over to Fighter Command, the original set remaining at Harwich.

ibid. Encl.12A. 18.8.40.

ibid. Encl.13A. 20.12.40.

News of the trials of the Harwich set does not appear to have reached the Air Officer Commanding, Balloon Command (Air Vice-Marshal O.T. Boyd) until the middle of August, for on the 18th of that month he wrote to the Air Ministry requesting full details and at the same time expressing the hope that, if successful, the instrument would be ordered in substantial quantities as he was becoming increasingly concerned over the casualties caused by balloons to friendly aircraft. No less than four had been destroyed in the previous week. The Air Ministry in reply, informed Balloon Command that both Bomber and Coastal Command had asked that all balloon barrages should be equipped with this instrument; that in the larger barrages several sets would be required in view of their limited range; that the sets would need very little attention; and that arrangements would have to be made for a channel of communication through which orders for the operation of the sets could be passed.

ibid. Encl.18A. 23.8.40.

By the 23rd August, it had been decided to instal the four original sets in the balloon barrages at Dover, Thames Estuary, Hull and Billingham, and that in siting sets, when available in sufficient quantities, the policy would be to locate them in all barrages so that they would radiate warning to a minimum distance of eight miles from the whole perimeter of each barrage.

/The Director

ibid.
Encl.17A.
21.8.40.

The Director of Signals, Air Ministry, wrote on the 21st August -

> "In view of the need for early production and in view of the successful trials already carried out I consider it unnecessary for further tests to be made. I therefore, ask that you will accept the R.A.E. model as it now stands for introduction into the Service without modification or service trials and that you will give the matter of producing the 100 sets a very high priority".

ibid.
Encl.11A.
18.8.40.

In a letter to the Air Ministry dated the 18th August, the Air Officer Commanding-in-Chief, Bomber Command, while urging the supply of these sets at all barrages as soon as possible, also asked that immediate consideration should be given to their installation in merchant ships sailing in convoy with Balloon protection.

ibid.
Encl.30A.
5.9.40.

On the 5th September a meeting was held at the Air Ministry at which the position was reviewed to date. It was decided that, where the required minimum radiating distance of 8 miles could not be obtained by one centrally placed set, several sets should be provided on the perimeter of barrages, and that the location should always be on a balloon site where crews would be available to operate them. It was considered that the Admiralty would not be likely to accept the installation and operation of Squeakers in convoys as they would unavoidably disclose the position of the ships. It was agreed that the sets should operate continually at night, as well as in conditions of low visibility (i.e. less than 5 miles) or when balloons were flying in or above cloud. The decision on visibility would lie with the barrage commander who would be responsible for the operational use of the sets, while the administration of the service would be a matter for Balloon Command. The original order for 100 sets had been doubled, but there was as yet no information when the first set would be available.

ibid.
Encl.38A.
12.9.40.

The question of providing some means of indicating the failure of a set to operate was discussed, and it was agreed that the Royal Aircraft Establishment should investigate means to attain this end. In the meantime it was proving in practice that the Squeaker sets were continually becoming unserviceable; the inevitable teething troubles were being encountered.

ibid.
Encl.45A.
18.9.40.

Having considered the detailed requirements for the Squeaker programme, Balloon Command prepared an estimate of the number of sets needed in barrages to provide the minimum radius of warning. From this it appeared that 130 initial sets were needed, and with a minimum of 50 per cent reserves (in some barrages 100 per cent reserves were considered necessary) a further 97 were required; an additional 74 for repairs and maintenance, new barrages and reserve replacements, brought the total to 300 which the Command requested should be provided. With the exception of Port Talbot and Blyth, both of which were initially equipped with only one Squeaker, no barrage was given less than two sets with two reserves. Large barrages such as Glasgow and London were provided with as many as eight Squeakers with 50 per cent reserves.

ibid.
Encl.50A.
15.10.40.

All necessary details about the Squeaker, as it was now officially called, were circulated on the 15th October to all formations in Balloon Command down to squadrons, and preparations made for its installation throughout the Command.

ibid.
Encl.54A.
29.10.40.

It was anticipated that delivery of the sets would begin in November at the rate of about twenty a week, and a priority list approved, giving preference to the coastal barrages.

/Flying Training

ibid.
Encl.55B.
24.10.40.

Flying Training Command showed interest in Squeakers at this stage of their development, and asked to be kept acquainted with matters.

ibid.
Encl.58A.
6.11.40.

Anticipating the arrival of the first sets, Balloon Command took steps to have five non-commissioned officers and ten aircraftmen established to carry out the installation work required, the personnel to be based on Cardington, while an additional electrician was also considered to be necessary inevery squadron for maintenance purposes.

ibid.
Encl.64A.
22.11.40.

ibid.
Encl.79A.
22.2.41.

Full details of the Squeaker apparatus were sent to the Admiralty towards the end of November, in connection with Bomber Command's suggestion that Squeakers should be installed on ships in balloon convoy, but it was not until further investigations had been carried out that it was determined that it would be possible for an enemy aircraft or surface vessel, equipped with a high-powered receiving set, to pick up signals from the Squeakers and thus obtain bearings on a convoy using them. The distances over which these signals could be picked up would be from zero to 40 miles, and again over 200 miles away. In the circumstances the idea of supplying convoys with Squeakers was abandoned.

ibid.
Encl.91B and C
2.3.41.

In the meantime production had been held up, due partly to modifications introduced as a result of the experience gained with the prototype, partly to enemy bombing action and partly to a shortage of certain components. However, the first six sets were sent to Cardington on the 2nd March, 1941, for delivery to Harwich Barrage, and it was anticipated that the original rate of delivery of twenty weekly would be maintained in the future.

Balloon Marker Lights

S.6420
Encl.36A.

The great difficulty experienced in obtaining Squeakers made it necessary for an alternative device to be sought as a temporary measure. The method adopted was to provide a red neon light, visible in clear weather at a distance of 50 miles, at points approximately 5 miles to the north and 5 miles to the south of balloon barrage boundaries. A steady light distinguished the northern light from that in the south, which was fitted with a cam, causing it to flash every twenty-five seconds. These devices were known as Balloon Marker Lights, and were installed only at coastal barrages. These comprised Tees, Hull, Forth, Tyne (including Blyth), Harwich, Thames Estuary, Portsmouth Southampton, Bristol and Liverpool.

The markers were illuminated between dusk and dawn and, when necessary, in daylight during conditions of poor visibility. Balloon squadrons in the barrages concerned were responsible for operating and maintaining the marker lights, for each of which a crew of one Corporal (ACH), one aircraftman (electrician), and one aircraftman (fitter MT) were established. Despite these skilled crews, the flashing markers had a high rate of unserviceability and it was necessary to fit new cams giving a flashing light of only five seconds duration.

The unserviceability of the markers presented a major problem for it was, of course, necessary to inform all friendly aircraft when they were not functioning. To this end, from the inception of the scheme, Headquarters, Balloon Command, had agreed to notify all Commands at home by immediate signal, as soon as a marker was reported unserviceable.

/But

But communications proved much too slow, and Balloon Command were instructed to inform Air Ministry (F.O.6(d) who undertook the responsibility of circulating the information to formations and units concerned.

The marker lights were constantly re-sited for a variety of reasons; for example, many persons living in the vicinity of the lights were of the opinion that they were the cause of unwelcome attention from the enemy.

Change of Policy

ibid. Encl.244A.

A change of policy in the operation of the marker lights was made in January, 1941, when it was decided that they should be doused in areas where attacks were threatened or were in progress. But by this time the manufacture of Squeakers had been speeded up and immediately afterwards instructions were issued for the withdrawal of the markers, which was completed by the 12th March 1941.

Enemy Aircraft

From the beginning of the war it was apparent that the German Air Force regarded our balloon defences with the utmost respect and on very few occasions did enemy aircraft set out deliberately to penetrate the barrage in order to bomb specific targets. Some low flying, by bumper-fitted aircraft, (1) was attempted, and later the Kutenaze (2) cutter was fitted to raiding aircraft, but both these devices appear to have been regarded as an added insurance against accidents, rather than a deliberate attempt to neutralise our barrages.

In 1940, when the Luftwaffe was numerically superior to our own Air Force and were content to carry out bombing at low level, even against what in those days was considered heavy light arms fire, it was particularly noticeable that in enemy attacks against balloon-protected areas in this country bombing was invariably carried out at a greater height. It may have been that these attacks were not so much against our war potential as against our morale; in any case German aircrews flying over our large industrial cities must have realised that no matter where their bombs were released they would find some kind of target. Whatever the reason, the fact remains that many of our vital plants and factories, which through their distinctive building features - and in the case of many London power plants, their close proximity to the river - were difficult to camouflage and must have been quite clear to the daylight raiders, did not receive the close attention from the enemy that was to be expected. All these targets came within the barrage areas and it is safe to say that but for the protection afforded, there would have been a very different tale to tell. Rotterdam, which had no balloon protection, can be cited as an example.

The layman, apt to judge the efficiency of the barrage in terms of "kills", would no doubt conclude that it was a greater menace to our own aircraft than to that of the enemy, but in this respect it must be remembered that all friendly pilots were - or should have been - warned of any barrage areas near their proposed courses. Many of the friendly aircraft that ventured into the danger areas did so either in a spirit of adventure or through extreme carelessness for which unfortunately many aircrews paid with their lives. A similar fate awaited the Luftwaffe had its pilots been intrepid enough to try.

/Several

(1) See Section 15

(2) See Section 15

S.B.1832
Encl.38A.
12.11.40.

Several instances of the respect of German aircrews for our barrages have been recounted by Prisoners of War during interrogation. One, discussing an attempted raid on Swansea, remarked that -

> "...It was planned to take place in mid-September but was frustrated by balloons. A glimpse of a number of these between two layers of cloud frightened the aircraft off and the bombs were finally aimed at three ships in the Bristol Channel..."

The purpose of the barrages was not so much to bring down enemy aircraft as to force them to keep flying at heights where our own fighter and anti-aircraft guns could engage them, and the extremely small number of penetrations and collisions is added proof that the desired result was achieved. Of the few enemy aircraft which collided with balloon cables, a small percentage were claimed by Anti-Aircraft Command and Fighter Command on the grounds that they were at the time out of control due to hits by Anti-Aircraft gun-fire or from fighter engagements.

ibid.
Encl.66A.

AHB/IIH/240/4/135
~~FO/S.20299~~
Encl.7C
20.6.40.

The first recorded victim of a British balloon unit was a German aircraft (believed to be a JU.87) which collided with an unarmed cable at Le Havre in the early hours of the 4th June, 1940. The aircraft struck the cable at 700 feet and crashed. Not until the night of the 19/20th June, 1940, did Balloon Command open its score against the enemy. On that date during a night dive-bombing attack on Billingham, a Heinkel III struck a balloon cable at 1,500 feet and crashed into the Tees nearby. Several claims were made which could not be verified and many enemy aircraft collided with cables but were able to proceed; without doubt many of these failed to reach their home base. It was inevitable that some "kills" also brought tragedy in their train. On the 13th September, 1940, at 0330 hours a Heinkel III fouled a cable at Newport (Mon.) and crashed from 2,000 feet on a tobacconists shop within a mile of the balloon site. Both aircraft and shop caught fire, and in spite of all efforts by the balloon crew to rescue them, two children - a boy and a girl - were killed.

S.B.1832
Encl.120A.
15.9.40.

It is not intended to give the circumstances of each collision; to do so would, in most cases, be mere repetition, but two distinctive features recur:-

(1) A tendency on the part of the aircraft to "climb" the cable, and

(2) the frequency with which aircraft were turned completely round and in some cases made off - after breaking the cable - in the direction from which they had come.

Many enemy aircraft collided with cables and escaped serious damage, due in most cases to the ineffectiveness of the D.P.L. attachment and the inexperience of the crews in the early stages of its employment, but it can be stated that the number of collisions that resulted in crashes was satisfactory in comparison with the total.

There were fifty-four collisions (1) between enemy aircraft and balloon cables during the war, twenty-five of which resulted in "kills". Twenty-two aircraft were known to have escaped - one of which force-landed in France - while the fate of the remaining seven is uncertain.

/SECTION 30.

(1) For complete list of collisions between enemy aircraft and balloon cables see Appendix "1".

SECTION 30

OPERATION "OVERLORD" AND THE EMPLOYMENT OF BALLOONS ON THE CONTINENT.

Definition of Balloon Policy in connection with Invasion Plans.

The use of balloons for large -scale amphibious operations of planned assaults was never considered seriously in the early stages of the war. As far back as December 1941, a sub-committee of Combined Operations planners, discussing assault landings, decided that a Force Commander would be better served by utilising any available shipping space for extra anti-aircraft guns rather than for balloons. The estimated high wastage rate of balloons during the assault, together with the weight of hydrogen cylinders and equipment required for maintenance and the considered need for anti-aircraft guns to protect the balloons, all contributed to the decision that balloons were a luxury, extravagant in shipping space and unnecessary for protection in areas where fighter aircraft could operate. Nevertheless, preliminary plans formulated early in 1942, both at the Air Ministry and Combined Operations Headquarters, visualised the use of mobile balloon barrages for the protection of Continental ports when captured, but no definite requirements were laid down. Considerable divergence of opinion existed amongst the various planning staffs as to the comparative value of L-Z and Mark VI balloons for this purpose. The L-Z type of balloon could not be used in the early stages of an assault owing to the large amount of shipping space required, whilst the Mark VI balloon with its limited operational height of only 1,500 to 2,000 feet was considered to be insufficient to act as a deterrent to attacking enemy aircraft.

A.E.A.F./10/ 14842/10/ Admin. Encl.17A.

Ibid. Encl.5A.

During the summer of 1942, exercises in combined operations were carried out in Scotland and use was made of Mark VI balloons. In the light of experience gained in the course of these exercises, and as a result of discussions with pilots and other interested parties, Air Commodore F. W. Walker (of Combined Operations Training) began to consider that the Mark VI balloon barrage for beach protection might be a practical proposition, and that its advantages as a deterrent to low flying attacks and the good moral effect it might have on ground forces more than outweighed the disadvantage of difficult maintenance. In July balloons were used successfully in another combined operations exercise, as a result of which Major General Gregson Ellis (Home Forces) decided that the policy of employing balloons to assist the anti-aircraft defence of ports and beaches should be examined.

Ibid. Encl.11A/B.

Balloons took part in the landings at Dieppe on the 19th August, 1942 - two flotillas of Landing Craft (Tanks) being fitted with Mark VI balloon winches and carrying the necessary balloons and equipment. It was intended to inflate the balloons after the tanks had been unloaded in order to provide protection for the landing craft when standing off the enemy shore, and on the return journey. They were never flown, however, as the concentration of fire was so heavy that either the hydrogen cylinders were holed, or the personnel injured in many of the landing craft, whilst any attempt to inflate balloons would have been abortive as they would have been holed by the volume of fire. However fighter protection and concentration of anti-aircraft fire prevented any low flying attacks against the landing craft. As a result of this experience, it was considered that balloons were of no value in a concentrated assault, particularly where fighter cover and anti-aircraft protection could be provided.

/Meanwhile

ibid.
Encl.24A.
DESTROYED
KBC/5144/7
Ops.
Encl.73.

Meanwhile the Directorate of Fighter Operations at the Air Ministry had provided an appreciation weighing up the pros and cons of altering the policy laid down in 1941. The conclusion arrived at in which the Air Officer Commanding, Balloon Command, concurred, was that Mark VI balloons were unlikely to fulfil any useful purpose but that L-Z balloons might be used to protect base ports and beaches. This was followed up in October 1942, by a decision of the anti-aircraft sub-committee of the special planning staff at Combined Headquarters that L-Z balloons for the defence of captured ports were luxuries and could not be deployed under existing plans until D plus 42 at the earliest.

Thus 1942 ended with the various departments concerned with our invasion plans divided amongst themselves on the subject of the value of balloons as a whole, and those in favour of balloons in general sub-divided again on the type of balloon required.

The subject appears to have been put into cold storage until August 1943, when discussions arose once more as a result of the successful use of beach balloon units in the invasion of Sicily.(1)

WO2/15/8
Encl.3A.

One Mark VI beach balloon unit was provided from the United Kingdom for this operation and a number were provided from the resources of the Middle East and North Africa Commands. Those already in the Mediterranean Air Command were given rigorous training and although, with one exception, they were unable to take their balloons ashore flying owing to the inefficient stowage of equipment on board the assault craft, barrages were soon set up on the beaches and proved to be a successful deterrent to enemy dive-bombing attacks. After the initial assault balloons were taken ashore inflated and used for the protection of captured ports as well as for the beaches.

As maintenance through the beaches was vital to the success of our invasion plans, the Directorate of War Organisation at the Air Ministry drew the attention of the Special Planning Forces to the successes achieved in Sicily, and suggested the re-examination of the balloon question with a view to forestalling last minute requests for balloons for "Overlord" for which provision was not being made at that time.

ibid.
Encl.1A.

As a result of this request, the matter was submitted to the Air Commander-in-Chief, Fighter Command (Air Marshal Sir Trafford Leigh Mallory) for a ruling, as although the planning staffs did not consider balloons an essential for beach and port defences, in the conditions that were stipulated for a successful assault the Allies would have complete air superiority and Mark VI balloons would be less dangerous to our own aircraft than an equivalent weight of anti-aircraft weapons. On the 21st August, Air Marshal Leigh Mallory gave his ruling stating, "The last thing I want is to have fighters tied up indefinitely protecting the beaches, as they will be required for offensive operations. Consequently the beaches should be as strongly defended as possible and as soon as possible".

AEAF/10/
11842/10.
Admin.(passim)
and Ms.26-28.

With the long delayed decision thus clearly given it was possible at last to proceed to work out the detailed requirements of balloons for the invasion of the Continent.

Planning Requirements for "Overlord"

In August 1943, when it was decided that beach and port protection for operation "Overlord" should be given by Balloons, there were few balloon resources available for a "Second Front".

/In the

(1) See pp. 440-443.

AHB/IID/34/5/14
~~KBO/8.52069~~
Org.(Passim)

In the previous March, Balloon Command had been warned that two L-Z Squadrons, each of forty balloons, might be required for Continental operations, and in order that such units could be available at short notice personnel and equipment were earmarked for these squadrons from the resources of Nos.992, 994 and 995 Squadrons at Salisbury, Canterbury and Norwich. Preliminary weapon and field training was undertaken, although the squadrons continued to operate in the existing home barrage, with certain adjustments to facilitate training. In addition, sufficient personnel had been trained and equipment assembled to form two Mark VI squadrons, each of forty-five balloons, for general but unspecified overseas requirements. These squadrons had not actually been formed, although the Squadron numbers 986 and 988 had been allotted.

AE/F/MS 13296 Encl.22A.

No firm plan nor details of requirements were set out at this date and the planners still appeared to be toying with the idea of using L-Z balloons. When it was pointed out by O.4 branch at the Air Ministry that for invasion purposes each L-Z balloon would require 100 hydrogen cylinders as backing, whereas each Mark VI balloon required only 15, the idea of using the L-Z balloons, even for base ports, was definitely abandoned.

Whilst requirements were still in process of formulation, the Air Ministry was pressing for further economies in manpower and it was recommended that drastic cuts should be made in the balloon protection of the United Kingdom. As a result, during October, the Air Ministry instructed Balloon Command to effect reductions to the extent of two thousand personnel in addition to the reductions already effected in the 1943(1) reorganisation. This drew an immediate protest from the Commander-in-Chief, Fighter Command, who had already prepared proposals for re-organisation of balloons, both for the reduced anti-aircraft defences of Great Britain and for "Overlord", but was waiting firm details of requirements for the invasion before dealing with any manpower reductions in home defences.

ibid. Encl.18A.

Balloon Command were now in the difficult position of being asked to dispense with balloon operators at a time when they were unaware of what they would be asked to provide for the invasion, when few of their remaining Air Force personnel were fit for overseas, and when it was not known how many Air Force crews of those required for "Overlord" would need to be replaced by airwomen. Furthermore the difficulties of accommodating Women's Auxiliary Air Force crews on sites, not prepared for them, would make any such substitution a long-term policy. As it was considered that three months training would be required for any Mark VI balloon operators required for the invasion, the lack of definite information on which to base a training and organisation programme hampered any attempt at preparation of overseas forces or reduction of home defences.

On the 2nd November, a conference was held at Headquarters, Fighter Command, attended by representatives of Balloon Command. In the absence of any firm planning details, Balloon Command confirmed that they could find up to five hundred Mark VI balloons for overseas. On the assumption that the minimum total needs for permanent balloon defences on the Continent would be three hundred balloons it was decided that the only course open was to proceed forthwith with training of personnel up to this minimum requirement. It was also decided to include tandem balloon training in case the service trials then being undertaken were successful, as a result of which tandem balloons might be needed on the Continent.

/Following on

(1) See pp. 475-482.

Following on this decision came instructions from the Air Ministry that any suspension of the order for the reduction of Balloon Command by two thousand personnel could not be agreed, as allowance for this reduction had already been made in assessing the manpower requirements for 1944. A complicated situation had now become more complicated; on the one hand Balloon Command were forced to give up two thousand men, on the other hand they had to spare men from existing barrages to be trained for overseas, while Fighter Command could not put forward proposals for further reductions at home in the absence of knowledge of requirements for the Continent.

Pressure was brought to bear upon the Allied Expeditionary Air Force planning staffs at Norfolk House. At last, the "Overlord" planning staffs, with the assistance of Balloon Command, prepared a preliminary estimate of the total requirements of balloons. It was considered that:-

A.E.A.F./10
Enc.18A.

(i) All ports on the south coast planned for use as embarkation points must be protected by existing L-Z barrages (reinforced, if necessary, by L-Z balloons from areas not directly threatened), or by Mark VI barrages.

(ii) Beach protection should be given on a scale of fifteen balloons per thousand yards.

(iii) Ports of disembarkation should be protected by Mark VI balloons only.

(iv) Base Ports on the Continent would probably not require L-Z or Mark VI balloons for protection, but if the situation required it, arrangements could be made to provide this from home resources.

As the British beaches would have a frontage of twenty-eight thousand yards the total number of balloons required (on the basis of fifteen per two thousand yards) would be two hundred and ten. Two special ports of disembarkation were being planned (the Mulberries) for protection of which one hundred and eighty balloons were required. In addition the strengthening of existing barrages at home ports would involve an additional 175 Mark VI and 18 L-Z balloons, making a total estimated requirement of 565 Mark VI and 18 L-Z balloons involving the employment of approximately 1,300 airmen balloon personnel, excluding officers and administrative staffs.

On the 12th November, Fighter Command were informed that the estimate of 565 Mark VI balloons had been agreed in principle and that arrangements to provide and train the necessary man-power could be put into operation.

A.E.A.F./MS
13296
Encl.25A.

This made it possible to go ahead with the proposals for the reduction of Balloon Command at home and the Air Officer Commanding-in-Chief, Fighter Command, put forward his detailed proposals on the 14th November. These included the elimination of all L-Z barrages (with the exception of Brockworth) north of a line Severn to the Wash and west of a line Wash to the Forth, excluding Rosyth and Scapa. Barrages south and east of this line were to be considered as permanent including the Mark VI balloon barrage at Dartmouth, and the mobile squadrons which were now to be stabilised.

/Full details

Full details of this reorganisation (known as the 1944 reorganisation) have already been given elsewhere in this narrative (1) but the net result of such a reduction was to be the release to other Commands of approximately 4,500 officers and airmen, in addition to the provision of the personnel required to undergo overseas training in connection with "Overlord".

The numbers to fulfil the estimated needs of the invasion were assessed as:-

	Officers & airmen
"Overlord" commitments	2,012
Temporary organisation required in the United Kingdom for training and administration until launching of "Overlord"	1,138
Manning of Admiralty hards for assault stage of operation	393
Total	3,543 (2)

In addition 498 personnel were still required for the two Mark VI squadrons (Nos.986 and 988) which had been authorised for overseas, though not for "Overlord".

Thus only little more than six months before D day was it possible to take action to commence the task of forming special balloon units for the invasion. The delays in making the various policy decision, due to lack of liaison between the Air Staff branches at the Air Ministry, the "Overlord" planners at Norfolk House and Fighter Command might well have had serious effects upon the efficiency of the balloon units employed; that they did not is due to the initiative and hard work of Balloon Command who, in the midst of constant major reorganisations and soon to be burdened with balloon defences against enemy flying bombs, concentrated all possible effort in training personnel, assembling equipment and forming new units.

Formation and Organisation of Balloon Units for "Overlord"

ibid. Encl.28B.

To meet "Overlord" requirements the estimate of 565 Mark VI balloons was originally made up as follows:-

(i) For Assault Beaches and Mulberry

14 Beach balloon units of 15 balloons = 210 balloons.

(ii) For Continental Ports when Captured

5 Port balloon squadrons, with 10 flights (2 of 25 balloons, 2 of 20 balloons, 6 of 15 balloons) = 180 balloons.

(iii) For protection of Ports of Embarkation

3 Port balloon squadrons with 10 flights (2 of 25 balloons, 4 of 20 balloons, 1 of 15 balloons, 3 of 10 balloons) = 175 balloons.

565 "

/The port

(1) See Section 28.

(2) For further details see Section 28 pp. 475-482.

The port balloon squadrons were to be established as Nos.992 to 999 Squadrons inclusive and the fourteen beach balloon units were given the numbers 50 to 63 inclusive. Each balloon was to be established with Balloon Operators, and where a unit could not be attached to an adjacent Royal Air Force Unit, it had to be provided with a skeleton administrative staff to operate on an independent mission.

It was the intention to form these units by passing personnel through a basic training course at Cardington, subsequently forming them into flights and completing their technical training by flying Mark VI balloons in selected barrages in the "dead" areas from which static barrages were to be withdrawn. It was proposed that the port balloon squadrons should occupy the "dead" barrage areas as soon as the L-Z balloons had been made non-operational, but there was no liability for the Mark VI squadrons to provide defence in the event of an enemy attack, as there would be no certainty as to the number of balloons deployed at any given time, individual flights being withdrawn for special exercises in the course of their training.

ibid.
Encl.27A.

The men of the beach balloon units, who would be required to land with the first wave of assault troops, would also require special training with the parent beach units with whom they would ultimately operate. These beach units were responsible for handling all Air Force supplies over the beaches to the advanced landing ground, and the beach balloon units would therefore provide their protective umbrella.

The personnel of the two Mark VI squadrons previously earmarked for overseas had already undertaken their basic training at Cardington. Consequently at the end of November, a start was made by dispatching these men to No.958 Squadron, Swansea (a barrage scheduled for elimination) and replacing them at Cardington with the Swansea men for training.

AUB/HD/34/4/26(A)
~~KBC/52299/Ops./1~~
~~Encl.12A.~~

From the trained Mark VI balloon operators at Swansea, parties equivalent to two beach balloon units - two officers and sixty-two airmen-were attached in relays to the other Air Force beach units, to be instructed in their duty of providing balloon protection on the beaches during the assault phase. This procedure was to be continued until all fourteen balloon units had been trained with their appropriate beach unit, the personnel remaining in Swansea meanwhile maintaining the L-Z barrage, whilst continuing their Mark VI training as far aswas practicable.

Authority was sought to release Balloon Command from their commitment of the two Mark VI Squadrons for unspecified overseas duties, in order to ease the burden of retaining the required number of trained Mark VI balloon operators over and above those required for "Overlord". Approval was given by the Air Ministry on the 6th December. This was made possible by the fact that balloon reductions were then being effected in the Mediterranean area from which any possible requirements for South East Asia could be met, if necessary.

For some time previously the United States planning staffs had been investigating the employment of American balloon units for the protection of their embarkation points in the United Kingdom and of their assault beaches. It was agreed by the British and American planners that a similar policy should be adopted for their joint requirements to facilitate provision of equipment, but here again the lack of definite information had hindered progress.

A.E.A.F./MS.
13296 Enc.30A.

/The Americans

The Americans planned to provide a Mark VI balloon battalion for their own sphere of operations, but as their balloon operators were not fully trained and had no operational experience it was suggested that they should be brought to the United Kingdom to operate in an existing barrage area either in South Wales or in Liverpool. Cardiff was eventually chosen for this purpose, and by the end of November arrangements had been made to deploy the American mobile barrage there as soon as the Royal Air Force barrage could be withdrawn.

By the time approval by the Chiefs of Staff and the Prime Minister had been obtained to the alterations in the Home Defences - in January 1944 - all these early arrangements had been subjected to considerable changes. American authorities at Headquarters, European Theatre of Operations, United States Army, were very concerned when they learned that the reductions agreed included the elimination of the barrages in South Wales, since the American Army was using the ports of Swansea, Port Talbot, Cardiff, Barry and Newport in connection with preparations for "Overlord". It was therefore decided to retain these barrages and to man them with the balloon personnel screened for possible defence against flying bombs,(1) in place of those already trained on Mark VI balloons. As the suggested importation of the American mobile squadrons for training at Cardiff never materialised, and the Swansea barrage had not then been replaced by Mark VI training balloons, it was agreed that the L-Z barrages in South Wales should remain deployed there until the flying bombs began, or until they were no longer required for port protection in that area.

AHB/IID/34/4/25 ~~KBC/52249/Ops.~~ Encs. 31A & B.

The barrages eliminated by the approved reduction were, therefore, Manchester, Liverpool, Crewe, Coventry, Sheffield, Derby, Glasgow and Birmingham, but the last named barrage was chosen as the area for training the "Overlord" port squadrons and flights, the training being directed from No.6 Balloon Centre (Wythal). Thus the 1944 reorganisation left all the South, West and South Wales major ports required for the invasion still protected by L-Z balloons, while the Midlands became the training ground of the Mark VI port squadrons. The personnel rendered surplus by the reorganisation were sufficient to man both the special commitments for "Overlord" and the defence against flying bombs, and leave 2,000 airmen and airwomen available for transfer to other Commands.

Initial establishments were issued in January 1944 for the port and beach balloon units, but these were subject to many changes during the next four months as experience was gained in trial operations of such units. The original fourteen beach balloon units of fifteen balloons each were formed into seven units of thirty balloons, allotted on the basis of two units per army beach sub-area. Each beach balloon flight was established with three servicing vehicles in the form of Bedford (Q.L. 4 x 4) tenders, fitted with a flexible drive from the gear box for operating the portable winches specially devised for "Overlord". Two vehicles out of every three were also to be provided with power winches to ensure against possible failure of the flexible drives.

AHB/IID/34/4/26(A) ~~KBC/52299/Ops.~~ Enc.53A.

In March a further unit - No. 57 Beach Balloon Unit - was formed for protection of an additional beach added to the invasion plan. Originally it was intended that the units scheduled for overseas should be transferred, when formed, to the Allied Expeditionary Air Force, or one of its subordinate

/formations

(1) See Section 31

formations, but it was later agreed that certain of the training particularly the technical training, could best be carried out in Balloon Command. The units were therefore established in Balloon Command with effect from the 19th February 1944, and No.6 Balloon Command (Wythal) became their parent administrative unit.

S.96836 Encl.8A.

A programme of training was drawn up to cover the period February to April so that all beach balloon units, after a period of attachment to their respective parent beach unit, should receive refresher balloon handling training at Cardington, deployment and handling exercises at No.12 Balloon Centre (Titchfield) and defence training at No.6 Balloon Centre (Wythal). During the same months a series of combined exercises was held at various points in the United Kingdom with the object of exercising assault personnel and landing craft in the different stages of the assault and build-up. Beach balloon units took part in a number of these exercises, flying their balloons from the ships of the Naval Carrying Forces engaged and practising the taking of inflated balloons ashore to set up a protective umbrella upon the beaches. The result of these exercises were carefully studied and everything done to improve the organisation and equipment to obviate any possible breakdown of the plans.

In view of the vital necessity of reducing the lift of vehicles and stores in the early days of the invasion it was agreed that the method of taking the flying balloons ashore from ships would be employed for "Overlord" itself, and that the beach balloons should be transferred inflated from the United Kingdom, carried on landing craft in sufficient numbers to maintain the beach units for the first seven days of the operation without the necessity of topping-up. This method of picking the balloons off the ships, like plums off a tree, was called the "Plumtree" system. An organisation was then set up to deal with the embarkation of the "Plumtree" balloons from various ports and hards in this country. Known as the Balloon Port Liaison Organisation, it consisted of officers attached to all points of embarkation, to ensure that hydrogen and equipment were available to produce inflated balloons in the correct numbers at the places required throughout the operation, by maintaining liaison with Naval Force commanders, Army Divisions concerned in the Assault, and Movement Control authorities.

A.E.A.F./S.17047 (passim)

The American Army were providing a balloon barrage battalion for the protection of their own beaches in the invasion area, but they required the assistance of Balloon Command for the initial inflation of their balloons before embarkation. The "Plumtree" system was also set up for them, and American Port Balloon Liaison Officers were appointed to work with the Balloon Command Port Balloon Liaison Organisation in the Falmouth, Plymouth, Portland/Weymouth and Dartmouth/Brixham areas. Balloon Command shore servicing stations(1) undertook responsibility for the operation of the American "Plumtree" from United Kingdom, with a supply of hydrogen from British hydrogen cylinders.

Meanwhile the port units were deployed to sites in the Birmingham barrage area and were trained under conditions to simulate those under which the units might be called upon to operate. Their training included the flying and repair of balloons with makeshift equipment, so that in an emergency the barrage should not become non-operational through lack of equipment. The crews were organised as parties of seven men

/per five

(1) See Section 14.

per five balloons so that flights of any size in multiples of five balloons from ten to twenty-five balloons (i.e. two to five crews) could be deployed as a port balloon flight. Where a barrage of thirty or more balloons was required two or more flights of suitable size were to be administered by a small headquarters.

All this time consideration was being given by the Air Staff of Headquarters, Allied Expeditionary Air Force, in conjunction with the Naval and General staffs, to the full organisation of balloon units required for the invasion, but their plans were continually altered as a result of the experiments carried out with balloons during the various combined exercises. By the beginning of April, however, they were able to produce a "draft of the "Overlord" plan for the balloon protection of beaches and "Mulberries"".(1) The three British beaches were to be protected from D. day onwards by beach balloon units which were to be transported to the Continent on D. day. During exercises it had been found that the flying of balloons from landing craft would be likely to give the enemy radar warning of the approach of the invasion fleet and therefore it would not be possible to fly balloons on craft reaching the lowering position before H-15; consequently 98 balloons were scheduled to be carried on the landing craft on the first tide and 102 on the landing craft on the second tide whose time of arrival did not fall within this restriction. This would provide for 180 balloons, each with their crew of two airmen and one light portable winch, together with 20 unmanned balloons, flying from short stays, to replace any casualties suffered on the voyage, the risk of which was increased by the limited flying height of 100 feet imposed by the Navy. After D Day an extra balloon was to be carried to the Continent by each landing craft, in addition to the balloon it carried for its own protection, and two-thirds of the landing craft were to carry Air Force balloons across the Channel as reinforcements; the remainder carrying Naval balloons for their own protection on both outward and return journeys. On the landing craft the Balloon could be flown either from the light portable winch or from the existing Naval winch, in which case the portable winch was to be taken ashore packed, the balloon being carried from the ship ballasted with sandbags. On landing craft in which a Naval balloon was already to be carried flying from the Naval winch in the bows of each craft, the Air Force balloon was to be flown across, attached to the ships' rail.

ibid. (passim)

Sixty balloons were required for the immediate protection of Mulberry 'B' at Arromanches and these were to be provided by two further beach balloon units to be deployed on D + 4. Port protection would be provided as the operation progressed, on request from the 2nd Tactical Air Force, and it was estimated that two hundred and ten balloons would ultimately be required for this purpose.

Any balloons required in excess of those already prepared for overseas ports were to be provided either by their withdrawal from home ports or by reforming beach units, on a port basis, when no longer required. Use and size of port units would only be decided by the course of the war and it was therefore necessary to retain them on a flexible basis so that flights and squadrons could be increased in size to meet individual requirements. The later training of port units therefore included the deployment of exercise barrages of varying sizes, by the transfer of flights from one squadron to another, and of balloons from one flight to another.

/In order.

(1) See appendix 'J' "Plan for British Balloon Protection - Operation "Overlord".

In order to cover exercise "Fabius" - a full-scale invasion exercise scheduled for early May and embracing all types of units - the Air Officer Commanding Air Defence of Great Britain gave orders on the 12th April that deployment of "Overlord" units to operational areas should be completed by the 28th April. Deployment of balloon parties for Admiralty shore servicing stations and hards to cover all embarkation points from Harwich to Milford Haven was completed by the 20th April, and by the 28th April the home port balloon squadrons and flights had moved to the ports they were scheduled to protect, thus:-

No.997 Squadron		Mark VI Balloons
No.111 Flight	Weymouth	20
No.112 "	Hamworthy	15
No.113 "	Portland	10
No.998 Squadron		
No.114 Flight	Newhaven	25
No.115 "	Shoreham	20
No.999 Squadron		
No.116 Flight	Torquay	20
No.117 "	Brixham	15
Individual Flights		
No.118 Flight	Fowey	20
119 "	Lepe/Stanswood Bay	20
		165 balloons

These home port units were to remain in Balloon Command unless and until required for transfer to overseas ports. In addition the L-Z barrages at Southampton and Portsmouth were augmented by a total of 18 balloons, drawn from the Scapa barrage.

The port balloon squadrons and flights destined for overseas were transferred to the 2nd Tactical Air Force or No.85 Group as appropriate, but were to remain as lodger units at No.6 Balloon Centre until called forward for the Continent. In early May these squadrons were re-established in accordance with the reqonsidered requirements of the Allied Expeditionary Air Force:-

No.992 Squadron	Mark VI Balloons
No.101 Flight	25
No.102 "	25
No.994 Squadron	
No.105 Flight	25
No.106 "	20
No.996 Squadron	
No.109 Flight	15
No.110 "	15
Individual Flights	
No.103 Flight	15
No.104 "	25
No.108 "	15
No.120 "	10
	190 balloons

Nos.933 and 995 Squadron Headquarters and No.107 Flight were dis-established, their balloons having been absorbed into the other port units. It was considered that balloons in excess of the 190 provided might be required in due course, but in such a case, they would be drawn from the home port units.

AHB/IID/34/2/1
~~KBO/MS 52229/Ops. (passim)~~

As a result of experience gained from the combined exercises two further steps were taken. Firstly, six of the beach balloon units, (Nos.50 to 55) were reformed into three squadrons (No.974, 976 and 980 Beach Balloon Squadrons) one for each of the three British assault beaches, and transferred to the 2nd Tactical Air Force on the 20th April. No.974 Squadron to work with No.2 Beach Squadron, and No.980 Squadron to work with No.4 Beach Squadron, were both moved to Southampton. No.976 Beach Squadron to work with No.1 Beach Squadron, was moved to Portsmouth. The two remaining beach balloon units (Nos.56 and 57) scheduled for the protection of Mulberry 'B', were provided with a small administrative Headquarters formed as No.991 Squadron, which was transferred to the 2nd Tactical Air Force on the 26th April.

The second step, made necessary as a result of exercises, was the provision of marine craft for the Port Liaison Organisation. It was found that balloons could not always be transferred to landing craft alongside a landing stage and also that those already flying from landing craft at assembly points needed servicing and hydrogen, which had to be transported to them. Steps were taken therefore to provide Air Force marine craft to augment the "Small Vessel Pools" at certain embarkation ports for the primary purpose of ferrying "Plumtree" balloons from hards and jetties out to the landing craft and servicing them when flying from craft at assembly.

All these results had not been achieved without a tremendous amount of detailed work in connection with the organisation, equipment and training of the balloon units.

The stated requirement for balloons to take part in "Overlord" came so late in the day that the problem presented to Balloon Command was how to complete balloon and other training in the limited time available. Once special units were formed it was found essential that they should continue their training together, so that they might work efficiently as a team and an integral part of the landing forces. As far as the beach balloon units were concerned the beaches were to be under complete Army control, an Army beach sub-area being set up for each to include two Army beach groups and one Air Force beach unit, to which the beach balloon unit was attached. As it was necessary for the Royal Air Force units to be at home in an army organisation most of the training for the beach balloon units was under army supervision, which meant the appointment of balloon training officers to visit these units at their training locations and instruct and exercise the personnel in balloon handling. In addition, the officers of the beach units were themselves instructed in field training, treatment of mines and booby traps, and other types of assault training so that they might, in their turn, teach the men of their own units. Everyone had to be familiar with the handling of sten guns, rifles, hand-grenades and machine-guns, and the beach units had to be competent in both dry and wet shod landings when taking their balloons with them. Transport drivers also had to be trained in waterproofing and de-waterproofing of vehicles. All this training (which was perhaps less familiar to balloon operators than to other branches of the Royal Air Force) required a highly efficient direction and organisation by staff officers at Balloon Command and Balloon Groups.

/Technical

Technical equipment was another subject which needed detailed study if it was to fulfil the stringent demands which would be made upon it. Until a definite decision was given on the type of balloon to be used and the approximate number required little provisioning action could be taken. The planned need was for the beach units to be backed by sufficient equipment to operate and maintain their barrages for at least forty days, while the period of operation of the overseas port units was an indefinite one. The Mark VI balloons to be used, flown from piano wire, were to be fitted with the latest type of bomb/parachute arming, and provisioning had to be made for these balloons and ancillary equipment, based on a hypothetical casualty rate, to which the casualty rate suffered in the Sicilian invasion offered only a very rough guide. The immediate reserve of balloons was fixed at 800 per cent of the initial establishment for beach balloon units, and 600 per cent for port squadrons; this proved ample for all requirements. In addition 300 initial establishment and 450 reserve balloons were required for training, backed by a monthly wastage rate of 100 per cent.

For the beach units a type of portable hand winch was a necessary item. The Balloon Development Establishment at Cardington evolved one which could be wheeled like a barrow, had a compact reel, was provided with attached insulation mats and could be used with any type of cable and armament. But even this light portable winch required four men to carry it from ship to shore and possibilities were investigated of providing flotation gear to assist in getting them ashore, but without success. Army help was enlisted, and it was found possible to land the winches with the aid of army personnel, drawn from those aboard each landing craft carrying a balloon.

Transport was another item of equipment which had to be specially supplied fitted to suit the conditions, and both beach and port units had to be supplied with vehicles equipped with special flexible winch drives. All this equipment had not only to be made available for D. Day but for exercises and training so that everyone concerned might be familiar with its handling and maintenance.

Supply of hydrogen was still another matter which required careful organisation and planning, so that cylinders would be available at all embarkation points for inflation purposes and ample numbers of filled hydrogen cylinders ready for embarkation and replenishment of barrages as soon as they were flying on the Continent. The overseas port balloons could not be carried inflated to the Continent owing to the impracticability of carrying inflated balloons from points of disembarkation to deployment areas. Therefore hydrogen cylinders and/or mobile hydrogen plants had to be provided for shipping with these units and, in the case of the latter, the necessary chemicals for operating the plants. Six hydrogen co-ordinating officers were appointed in March 1944, one to each Section of the South Coast, to ensure the maintenance of continuous supplies of hydrogen. These officers had the onerous task of organising the hydrogen supplies in their areas in such a way as to ensure that they would be available at whatever embarkation points might be in need of them. All road, rail and loading facilities had to be carefully studied and arranged accordingly, in conjunction with the Directorate of Movements at the Air Ministry. In order that there should be no breakdown in the supply from regular hydrogen factories in the United Kingdom, emergency hydrogen plants were set up at various points to augment the existing output as required. The problem of unloading hydrogen cylinders from landing craft before

/berthing

berthing facilities were available was also investigated, and special skids were provided to unload hydrogen until approximately D + 8, when it was anticipated that coasters would be able to take over the duty of delivery. These skids were not used in the actual operation, however, owing to the amount of deck space they required.

As far as establishments were concerned, the Sicilian balloon units served as a guide, but conditions on the Continent varied considerably from those in the Mediterranean area, and alterations and additions were made continually to meet special requirements only revealed as a result of the numerous exercises. In Sicily it had been found that the absence of Balloon Liaison officers on the staffs of higher formations had led to considerable waste of time and man-power when units had fulfilled their original purpose, as it was difficult for their commanders to obtain any policy rulings regarding reorganisation. During the early months of 1944, therefore, Balloon Liaison officers were established on the Headquarters staffs of the Allied Expeditionary Air Force and 2nd Tactical Air Force, and these officers, with their balloon knowledge, were able to assist materially in smoothing out the various balloon problems as they arose.

By the 31st May, a state of complete readiness was attained in accordance with the orders issued by the Supreme Allied Commander. Balloon Liaison officers were at their posts with the Allied Expeditionary Air Force formations concerned in the invasion. The Balloon Port Liaison officers were ready with the organisation to provide both Air Force and American army balloons inflated as required, whilst the Admiralty shore servicing stations were prepared to fit naval balloons to all types of craft, from liners to tugs, not scheduled to carry Air Force or American balloons. Disposition of balloons, equipment and hydrogen to their appointed areas had been made in collaboration with the Kite Balloon section of the Admiralty. Marine craft were at shore servicing stations to ferry the balloons and carry reinforcements to landing craft, and the home port balloon units were flying to protect the activities of British and American forces at all their ports of embarkation. Detailed loading tables had been checked and rechecked to minimise any chance of error in the distribution of beach balloon squadron personnel and equipment, which might prevent them flying and maintaining their barrage on arrival at the far shore. Personnel of the Air Force beach balloon units and of the American Balloon Barrage Battalion had been called into the concentration and marshalling areas. With everyone ready for their appointed tasks, all Balloon Command's preparations were completed for the assault upon the shores of Normandy.

D. Day and the early stages of "Overlord".

In the early hours of Tuesday, 6th June, a vast armada of ships carried the Allied Armies across the Channel, most of them carrying balloons for protection against enemy attack during their passage and their stay off the enemy-held shores, and many of them also carrying inflated balloons for protection of British and American landing beaches.

Active preparation for this undertaking had commenced on Thursday, 1st June (D - 4) when work was started on the loading of landing craft both at the Eastern (British) Task Force embarkation points of Felixstowe, Tilbury, Shoreham, Southampton, and Portsmouth, and the Western Task Force (American) areas of Weymouth, Portland, Brixham, Dartmouth, Plymouth, Fowey and Falmouth. The flying limit of 100 feet imposed by radar implications and to which all Air Force, American and Naval balloons alike had to conform while crossing the Channel on D - Day, greatly increased the risk of balloon casualties in bad weather. The weather was fine, however, on the first two days and no difficulties were encountered by the Port Balloon Organisation, and the shore servicing stations, but on D - 2 the weather deteriorated and the wind increased, causing several balloon casualties on craft at their assembly anchorages. On Sunday, the 4th June, a temporary postponement of the operation was announced due to the adverse weather conditions. Balloon casualties continued to occur and their replacement was made difficult by the rough seas and high winds.

AIR/5D/34/4/2 KBS/Tw 26 52299/ Ops. Enc. 51B.

/From a

From a balloon point of view the weather on Monday, the 5th June, could not have been worse. A heavy sea was running and landing craft were allowed to move to any points where they could find shelter. This necessitated the operation of emergency shore servicing stations at Warsash and Stanswood Bay. An attempt was made to obtain ferry craft for this purpose but although one from Portsmouth managed to reach Warsash, the one for Stanswood Bay had to turn back owing to the rough seas. The Naval authorities then predicted a further twenty-four hours postponement of the operation, but at 09.00 hours on Monday, the 5th June, instructions were received to replace all balloon casualties with the greatest possible speed as sailing was imminent.

The problem presented to the Port Balloon Organisation was a serious one, as the marine tenders supplied to ferry replacements were not suitable for rough seas and quickly became swamped. All shore servicing stations whose ferry craft could operate had to work at high pressure. Assistance, in the form of additional marine craft, was obtained wherever possible from Naval and Air Force bases, but the wind was still high and the transfer of balloons in mid-stream to fast moving vessels was not an easy task. In spite of all these difficulties, the speed of replacement was such that practically every vessel was carrying a balloon as they moved from their anchorages. At Felixstowe, for example, sixty balloons had been initially fitted at the hards and eighty-three had to be used for replacement either before or at sailing time. At Tilbury and Shoreham there were no balloon casualties unreplaced at the time of sailing, and at Portsmouth and Southampton there were not more than a total of eight or nine balloons missing from their craft. In the Solent-Spithead area alone there were between 350 and 400 balloons flying.

The American Army had an operational role similar to that of the Royal Air Force as regards the flying of balloons in the initial assault. No.320 Anti-Aircraft Battalion operated three batteries, each flying approximately fifty-five balloons. No.32 Group of Balloon Command made all the necessary plans for the move of their equipment, and for the operation of a "Plumtree" system for them.

DESTROYED.
KBO/TS/5489/Ops.
Encl.10A.

The American convoys set sail from Falmouth, Plymouth and other Western ports on D - 2, flying a total of 202 balloons. With the postponement of the operation, all convoys had to return to port, and under the most unfavourable weather conditions the balloons had to be serviced or replaced. At Plymouth a large portion of the convoy could not anchor in the Sound, and balloon servicing craft had to operate outside the breakwater in heavy seas, which caused several casualties. On D - 1 the convoy set sail again, every craft due to receive a balloon having been supplied with one, over 500 balloons including Naval balloons having been fitted.

One point which should be mentioned here is that alone of all the ancillary personnel engaged in the operation the men of the shore servicing organisation had full access to every landing craft, mixing freely with briefed troops. It is a high tribute to these men that no breach of security resulted as a consequence of their unique freedom of movement in the face of security regulations which were possibly the strictest that have ever been known. It is amusing to record here that when the "Overlord" security instructions were drawn up necessity for such freedom was overlooked, and Balloon Command was informed that their system of maintaining and replacing balloons, though admirable in practice, could not be allowed for the actual operation. Instant application to Supreme Headquarters resulted in all Hard Parties and men of the shore servicing organisation being absolved from the security regulations in this sense.

/As soon

As soon as the force had left the shores of Southern England the shore servicing stations became busy with the build-up for maintaining the beach barrages in full operation, and from D + 1 onwards every available craft carried a replacement balloon, either for the Royal Air Force Beach Balloon Squadrons or for the American Beach Balloon Battalion.

By the night of D. Day, all the beach balloon squadrons were flying a number of balloons and they steadily built up a satisfactory barrage. No.974 Squadron protected the beach east of Courselles, whilst Nos.976 and 980 Squadrons were located at Hermanville. No.976 Squadron suffered very heavy enemy shell and mortar fire and it was considered advisable to deflate the balloons for several days. Whilst this barrage was non-operational, their balloon operators were of considerable assistance to the Army, performing such duties as dismantling and guarding gliders of the Airborne Forces. Although it was intended that balloons should fly day and night over the beaches, some of the rearming and refuelling strips for fighter aircraft were in use by D + 4 and the need for control made it necessary to fly balloons by night only, in the vicinity of these strips. By D + 6, No.991 Beach Balloon Squadron was flying in protection of Mulberry 'B' at Arromanches, No.56 Flight flying 32 land-based balloons, and No.57 Flight 32 waterborne balloons to protect the artificial harbour. No.104 Port Balloon Flight had also been brought in to provide a barrage for the petrol base at Port-en-Bessin.

Forms 540.

The "Plumtree" system worked very well and hydrogen and packed balloons arrived according to plan, supplies of 144 cylinders and 10 packed balloons being phased in for each squadron as early as D + 1. The general opinion of all concerned was that the moral effect of the balloons had been of great assistance to the men unloading on the beaches, and on the few occasions when the Luftwaffe appeared over the area they respected the barrage and flew at a reasonable height.

There were few casualties amongst the Air Force beach squadrons, but the Senior Balloon Officer of the 2nd Tactical Air Force was seriously wounded when the Rhino ferry, on which he was coming ashore, was blown up by mines. His duties were temporarily assumed by the Commanding Officer of one of the beach squadrons without causing any hitch in the disembarkation and deployment of units.

In the meantime the three port balloon squadrons and four port balloon flights were still at No.6 Balloon Centre, ready to move to the Continent to protect ports as they were captured. No.976 Squadron was scheduled for Le Havre and No.976 Squadron for Rouen, but at the beginning of July a request was put forward by Headquarters, European Theatre of Operations, United States Army, for balloon protection of ports in the American sector at Cherbourg, Quiberon Bay and Brest. Protection for Cherbourg was required almost immediately on a scale of fifty balloons. Accordingly, instructions were issued by the Air Officer Commanding-in-Chief, Allied Expeditionary Air Forces, that the one hundred and sixty five home port balloons then deployed at invasion ports were to be withdrawn and reformed, at No.6 Balloon Centre, into three squadrons (two of fifty and one of forty-five balloons respectively). The protection of Cherbourg could then be found by bringing forward No.992 Squadron (already of 50 balloons) and annotating one of the new squadrons in its place for the protection of Le Havre.

/All the

All the home port balloon squadrons and flights were made non-operational therefore, and were disestablished with effect from the 12th July, as from the same date reforming in Balloon Command for No.95 Group as under:-

AHB/IID/34/5/15A1
~~KBC/MS52329/~~
~~Ops.~~
Enc.112A/B.

997 Squadron	Mark VI Balloons
111 Flight	25
112 "	25
998 Squadron	
114 Flight	25
115 "	20
999 Squadron	
116 Flight	25
117 "	25
	145 balloons.

Nos.118 and 119 Port Balloon Flights and No.113 Flight of No.997 Port Balloon Squadron were eliminated, the twenty balloons thus rendered surplus being used to increase the size of No.996 Squadron to the fifty balloons required for the protection of Le Havre. The original overseas port units still at No.6 Balloon Centre therefore became:-

992 Squadron	Mark VI Balloons
No.101 Flight	25
No.102 "	25
994 Squadron	
No.105 Flight	25
No.106 "	20
996 Squadron	
No.109 Flight	25
No.110 "	25
Individual Flights	
No.108 Flight	15
No.120 "	10
No.103 "	15
	185 Balloons

thus making a total of three hundred and thirty port balloons standing by at No.6 Balloon Centre available for Continental ports in the American and British Sectors. It was anticipated that No.992 Squadron and No.103 Flight (for Caen) would be called forward without delay, but owing to the German policy of holding the French ports to the bitter end, it was obvious that the remaining balloons would not be required for some time, and on the 22nd July, the remaining two hundred and sixty five balloons were phased back indefinitely by 21st Army Group.

This proved to be a blessing in disguise as far as home defence was concerned, as the flying bomb attacks were then at their height. Permission was obtained from No.85 Group to deploy their Mark VI balloons as a temporary protection against flying bombs and so gain practical experience of the

/bomb

bomb/parachute light-weight arming against these weapons.(1) The 265 Mark VI balloons were deployed east of Gravesend on the 24th July and remained there until the end of August. Owing to the fact that the Allied armies swept forward into Belgium, by-passing the majority of the French ports still held by the Germans, and that on the 11th August the United States 9th Air Defence Command relinquished their claim to port balloon protection, these port balloon units never fulfilled their original purpose.

On the 28th August, the Mark VI balloons were withdrawn from the flying bomb defences and replaced by an L-Z barrage. It was still thought possible that further increases might be necessary in the anti-flying bomb barrage, so Nos.994, 998 and 999 Squadrons were transferred from No.85 Group to Balloon Command on the 1st September, disbanded and reformed as No.965 Squadron of 40 L-Z balloons, designed to be held to meet further commitments in the United Kingdom. This reduced the total of "Overlord" balloons by 140, from 595 to 455 Mark VI balloons.

By the end of September the position on the Continent had undergone a rapid change. The Allied Armies, in their great push forward had centred all activities in Belgium and on the borders of Holland. It was obvious, therefore, that protection of such French ports as we held was no longer needed, there being little likelihood of any large-scale enemy air attacks, neither was there any reason for the retention of the beach balloon units, beach maintenance having been discontinued.

AHB/IID/34/5/15(B). ~~KBC/52329/Org/II.~~ Encl.15A.

The Air Force beach units having been withdrawn early in September, the beach balloon squadrons were left with no administrative headquarters and to provide this Headquarters, No.159 (Balloon) Wing was formed in No.85 Group on the 4th September and assumed both operational and administrative control of all the Mark VI balloons of the Allied Expeditionary Air Forces, whether on the Continent or earmarked for transfer there. Concurrently the title of No.991 Beach Balloon Squadron guarding the Mulberry at Arromanches was altered to No.991 Port Squadron. This step was followed by the withdrawal of most of the beach balloon units.

85G/S.68/Air Encs.21A and 30A.

During September, the Anti-Aircraft Divisional Commander of the defences of Caen and Ouistreham requested that No.976 Beach Balloon Squadron might be moved to the banks of the Caen-Ouistreham Canal to serve as a deterrent to enemy minelaying in the canal. There were no Air Force objections to this suggestion, provided that the move was not made until night fighters ceased operations from the adjoining airfield at Carpiquet. Progress of the Allied Armies was so swift, however, that the requirement for protection of the canal soon faded, and on the 30th September agreement was reached between all three Services that balloon defences could be dispensed with throughout the whole of the 21st Army Group area. Authority was accordingly given by the 2nd Tactical Air Force to withdraw Nos.974 and 980 Beach Balloon Squadrons to the United Kingdom, whilst the same authority stated that No.992 Squadron was no longer required for the Continent.

ibid. Encs.96D and 140A.

ibid. Encs.95D and 138A.

By the 5th October, the following units were at No.6. Balloon Centre awaiting official transfer to Balloon Command and further instructions as to their disposal:-

/Port Units

(1) See Section 31.

Port Units	Mark VI Balloons	
No.992	50	Released from Continental commitments.
No.996	50	Returned from flying bomb barrage, and replaced by L-Z balloons.
No.997	50	
No.108 Flight	15	
No.120 Flight	10	
No.103 Flight	15	Not required on the Continent.
Beach Units		
No.974 Squadron	60	Returned from the Continent and awaiting disbandment.
No.980 Squadron	60	
	310	

whilst remaining overseas were the following units:-

No.976 Beach Squadron	60	Retained for Caen-Ouistreham Canal, but not used.
No.991 Port Squadron	60	Mulberry 'B' at Arromanches.
No.104 Port Flight	25	Port-en-Bessin
	145	

No.965 Squadron, newly formed from the three port squadrons, was dis-established as a result of the Chiefs of Staff decision to disband all Balloon Command Squadrons at home, with the exception of a reserve of 800 L-Z balloons for possible flying bomb commitments.

It was considered that the remaining overseas units would be returned to the United Kingdom, No.159 Balloon Wing remaining in France until they had gone, when in its turn, it too would be disbanded, and the balloon chapter of "Overlord" would be closed. But by this time the Allied Armies had reached the west bank of the Scheldt, and the defence of the Estuary and the Port of Antwerp against air attack and mine-laying was already being seriously considered by the Naval authorities on the Continent.

The Scheldt Barrage

AHB/6D/34/5/17(A). KEC/S.52737/ Org.— (passim).

A glance at the map of Europe would show that the provision of an effective barrage for the Scheldt was a big undertaking. It was almost certain that water-borne balloons would be needed to protect the Estuary and at the time when the Antwerp requirements were just beginning to formulate, Balloon Command squadrons at home were being disbanded rapidly and equipment removed from water-borne barrages.

No definite official request for a Scheldt barrage was made until the end of October, but at the beginning of the month Balloon Command took the first step towards such a project and asked the Navy to hold up the dismantling of winches from water-borne balloon craft in the United Kingdom, in case these might be suitable for the new barrage.

/The first

The first official intimation came to Balloon Command as the result of a signal from Headquarters, 2nd Tactical Air Force to the Air Ministry on the 19th October, stating that a possible commitment existed on the Continent for 450 Mark VI balloons and 100 Mark VII (water-borne L-Z) balloons and asking for information regarding available barges. At this time there were 21 drifters, 61 dumb barges and 17 self-propelling barges left in the Command. The Admiralty agreed to delay the disposal of these craft until details of the deployment area and servicing facilities available had been received, thus making it possible to ascertain their suitability. Headquarters, 2nd Tactical Air Force's first signal was followed by another in which they issued orders that all No.85 Group balloons on the Continent were to move to Antwerp for protection of the Scheldt, followed by Nos.974 and 980 Port Balloon Squadrons from the United Kingdom, together with two L-Z squadrons.

This was putting the cart before the horse, as although the Mark VI Squadrons were under the control of the 2nd Tactical Air Force, Balloon Command was still the 2nd Tactical Air Force's technical adviser on balloons, and had not even been asked to undertake a reconnaissance of the proposed area. Moreover, the waterborne squadrons had not yet been formed, and until the types of vessels and moorings, required and available, could be ascertained, it was impossible to give advice on the organisation required. Provision of such a barrage raised a large number of administrative problems both for the Admiralty and Balloon Command, and Headquarters, Balloon Command, accordingly requested that a meeting should be held at Headquarters, No.85 Group, Ghent, to discuss the project in full, and to make major decisions regarding the nature of deployment. This was arranged for the 30th October, and meanwhile any preliminary action possible was put in hand. Nos.974 and 980 Port Squadrons (which had been disbanded at No.6 Balloon Centre on the 16th October) were re-established ten days later as two squadrons, each of fifty Mark VI balloons. On the same day, Nos.965 and 967 Squadrons, each of fifty L-Z balloons, were formed at Cardington from Balloon Command resources.

The meeting at Headquarters, No.85 Group, was attended by representatives of the 2nd Tactical Air Force, Balloon Command and the Directorate of Compressed Gases, Air Ministry, as well as the Commanding Officers - designate of the two L-Z squadrons, both of whom had considerable experience of waterborne barrages. It was revealed that some of the barrage area was still in enemy hands, but it was envisaged that the 100 L-Z balloons would be used to protect the Dutch portion of the Estuary - the outer Scheldt from the mouth to the Belgian border, and 300 Mark VI balloons for the Belgian section - the inner Scheldt and the port of Antwerp. If sufficient barges could not be made available for all the waterborne L-Z balloons, it might be necessary to fly Mark VI balloons from buoys, and for this purpose the balance of 150 Mark VI balloons were required in reserve. It became obvious at the meeting that No.85 Group had no conception of the magnitude of the task of organising and deploying the largest waterborne barrage ever to be flown, and they were only too ready to hand over the major portion of the work to Balloon Command. It was agreed that the two L-Z squadrons should be fully prepared by Balloon Command so that they might operate immediately on arrival on the Continent. As such a barrage could not be maintained without backing, it was proposed to expand Headquarters, No.159 Wing, into the equivalent of a small balloon centre on which balloon repair and hydrogen plant sections could be based.

/On the

On the 4th November, a conference was held at Headquarters, Balloon Command, attended by representatives of the Air Ministry and No.85 Group, to decide the detailed action required as a result of the previous meeting at Ghent. It was agreed that barrage control should be set up in the Anti-Aircraft operations room at Antwerp as well as at the two L-Z Squadron headquarters. The provisional siting plan for the two waterborne squadrons formed the basis of their establishment:-

No.965 Squadron

(with Headquarters at Terheusen) - 47 water and 7 land sites.

No.967 Squadron

(with Headquarters at Walsourden) - 39 water and 7 land sites.

The 300 Mark VI balloons were to be found from:-

(a) All balloon units in France (Nos.976 and 991 Squadrons, No.104 Flight)- 145 Mark VI balloons.

(b) Certain squadrons at No.6 Balloon Centre. (Nos.992, 974, 980, 996 and 997 Sqdns.) - 150

(c) One section of No.103 Flight - 5

Total 300 balloons

leaving at No.6 Balloon Centre a balance of 155 Mark VI balloons for transfer if required. Pending final clarification of requirements, it was also thought necessary to hold 60 - 70 landbased L-Z balloons for possible substitution of up to 200 Mark VI balloons, and for this purpose one L-Z balloon squadron was earmarked from the 800 L-Z balloons held in reserve by Balloon Command for the flying bomb commitment.

It was estimated that it would take three weeks to sweep the Scheldt channel, and as no waterborne deployment could take place until this had been done, it was agreed that Nos. 965 and 967 Squadrons should be brought to a state of readiness by the 27th November. Immediate arrangements were made for an advance party from each squadron to proceed to the Continent to assist in making arrangements for the arrival of their units. Owing to difficulties of wind and weather in the vicinity of Flushing, moored barges could not be used there, and a flight of mobile drifters was required in that area. A drifter flight could be equipped from drifters in this country, but it was thought more economical to use Belgian barges, if these could be obtained, for the rest of the waterborne balloons. The next step was to provide the necessary marine craft for these squadrons. This was accomplished by obtaining the major requirement of pinnaces from Coastal Command, who also supplied ferry crews to deliver them to Antwerp. Flying boat tenders and marine tenders were supplied from Air Ministry resources and shipped direct to the Continent.

Concurrently the necessary hydrogen plant was shipped, together with the personnel to operate it, so that supplies might be ready for initial inflation of the barrage. To make doubly sure of this, 3,900 cylinders of hydrogen were also shipped to the Continent.

/The difficulties

The difficulties of finding enough suitable barges and accommodation were increased by the lack of communication between the Wing and advance parties in Belgium on the one hand, and Balloon Command on the other. Local accommodation was proving difficult, and huts could only be distributed through 21st Army channels in view of a ruling by Supreme Headquarters to this effect. Such barges as were found available in Belgium needed to have winches fitted, and material supplied to build sleeping accommodation on board. To assist in the accommodation problem, Balloon Command endeavoured to obtain, through the Admiralty, the use of some old paddle-steamers. Owing to the fact that most of the waterborne barrage would be in Dutch waters, but flying from Belgian craft, the subject of the waterborne vessels became a matter of international politics between the Dutch and the Belgian Governments. Protracted negotiations presented another factor which hindered progress in deployment of the barrage.

The accommodation question was settled during November when the Air Ministry agreed to the establishment of 100 caravans, which were already available in Balloon Command, and these were shipped to the Continent as an addition to the few local billets which could be found. In addition a number of Air Force huts were handed over to the Admiralty for the purpose of building accommodation on the Belgian barges.

The "phasing-in" of the barrage was then arranged in stages. Nos.976 and 991 Port Squadrons, already on the Continent, were to commence flying a token barrage of 50 balloons from about the 22nd November. This was to be augmented, as soon as possible, by the arrival and deployment of Nos.992, 996 and 997 Squadrons from the United Kingdom. The next stage was the deployment of the two L-Z Squadrons and the barrage was to be completed by the arrival of Headquarters, No.974 Squadron and the five balloons of No.103 Flight, to be made up to its full complement by No.104 Flight from Normandy. No.980 Squadron and the flights remaining at No.6 Balloon Centre were to be held in abeyance pending further developments.

By the beginning of December, the Mark VI balloons from the United Kingdom had been transferred to the Continent, had joined up with those units already there and were flying a number of balloons around the port, thirty sites of No.976 Squadron and forty sites of No.991 Squadron being operational from the 28th November. Throughout December, Antwerp was receiving the full force of the German VI and V2 attacks and although the Squadrons received only a few casualties, three airmen of No.992 Squadron were killed, as well as two balloon officers in the Anti-Aircraft operations room at Antwerp.

The equipping of the waterborne craft was, however, still progressing very slowly. There were few shipyards available for the preparation of the drifters and it seems that these could not be made ready until the end of December. Three paddle-steamers, "Golden Eagle", "Jeannie Dean", and "Thames Queen" were being repaired at Home ports and prepared for use as flight headquarters for the waterborne barrage.

During the first week in December, the first Allied ship entered the cleared port of Antwerp, where Mark VI balloons were now flying, but the outer Scheldt still remained unprotected.

No.104 Flight, which was to form a part of the newly formed No.974 Squadron, was employed in an unusual role whilst awaiting final deployment to Antwerp. On the 20th October the United States 12th Army Group made a request to Supreme

/Headquarters

Headquarters for a unit of balloons which they required as target markers in a planned heavy bomber attack. No American balloons being available for the purpose, Headquarters, Allied Expeditionary Air Forces, was asked to supply fifteen balloons, together with crews, mobile winches and sufficient hydrogen for one inflation. The request was met from No.104 Flight which proceeded to Verviers (Belgium) on the 4th November, from where the United States 1st Army was about to make a heavy assault upon the German frontier in the vicinity of Aachen, reinforced by a large-scale bombing attack on enemy strong points. The bombers were scheduled to come over at an hour immediately preceding the ground attack, and the balloons were required to mark the bomb line so that bombs might not fall short of the targets.

AEAF/B.22368 Encs.36A - 39A.

On the 16th November, the day scheduled for the big attack, unfortunately the weather was sufficiently overcast to prevent the 8th Air Force from observing many of the balloons and the bombing had to be carried out with little aid from the bomb line markers. Nevertheless, General Omar Bradley, commanding the United States 1st Army, signalled Headquarters, 2nd Tactical Air Force, stating that

2nd TAF/30335/ Ops. Reg. Enc.55A.

> "the unit did a superior job under enemy fire losing twenty three balloons, eleven to enemy flak .... the loan of the Royal Air Force Balloon Unit has been greatly appreciated".

The flight completed its task and on the 20th November continued on its way to form part of the new No.974 Squadron at Antwerp.

By the second week in December, 191 Mark VI balloons were flying in the Scheldt area and by the end of the month this total had increased to 264. But very little progress was being made with the fitting of the barges for the waterborne balloons, which had been placed in the hands of Belgian civilian contractors at Antwerp and Ghent. Eighty balloon barges had been requisitioned but on the 1st January 1945, only eight had been completed sufficiently to fly their L-Z balloons. After Headquarters, No.85 Group, had made numerous appeals to Headquarters, 2nd Tactical Air Force and to Supreme Headquarters for help in bringing pressure to bear on the Belgian civil authorities, the work of fitting the barges progressed a little, and the drifters from the United Kingdom also began to arrive in the Scheldt during February. By the 25th February, 70 of the 100 waterborne sites were in operation, but by that time the danger of enemy mine-laying had greatly diminished.

85G/S.68/Air (passim.)

Meanwhile the Mark VI balloon personnel were continuing to operate under conditions of severe strain, owing to the VI and V2 attacks on Antwerp. On the 14th January, Headquarters, 2nd Tactical Air Force asked for the establishment of a reserve pool of balloon operators in order to allow personnel to be withdrawn from the barrage for a rest. No.980 Squadron, still held at No.6 Balloon Centre, was reformed as a squadron with two dependent flights, each of twenty-five balloons, and transferred to No.85 Group on the 19th January. The Squadron was sent to the Continent without any balloon technical equipment and located at the Base Personnel Centre at Blankenburghe, from where relief balloon crews could be drawn, as necessary, to replace men sent out of the Antwerp area for rest and leave.

2nd TAF/30335/ Ops. Reg. (passim.)

/The Rhine Barrage

SECRET

The Rhine Barrage

85G/S.68/ Air Enc.109A.

With the advance to the Rhine the danger of attack on Antwerp diminished, but on the the 13th March came a request from Supreme Headquarters that twenty-five Mark VI balloons should be withdrawn from the Scheldt and be used to form a protective barrage around the Remagen bridgehead, under the orders of the 12th United States Army Group. 'A' Flight of No.974 Squadron was selected for this task and moved to take up its new location on the 14th March. The next day this move was followed by a further request from Supreme Headquarters for fifty Mark VI balloons for employment with the 9th United States Army on bridgehead protection during the Rhine crossings. 'B' Flight of No.974 Squadron and 'A' flight of No.992 Squadron were chosen.

Form 540

On the 24th March, the flight from No.992 Squadron inflated twenty-four balloons at two bridges in the Rheinburg area in support of operation "Varsity" - the airborne operation across the Rhine. They commenced by inflating twelve balloons at each bridgehead, and then ferrying six of them across the river so that each bridge was protected at either end. A similar task was carried out at other bridges in the same area by 'B' Flight of No.974 Squadron. Enemy aircraft attacked the balloons each night and sometimes also by day; 30 per cent of the balloons were destroyed, but all were replaced immediately. Then, as the Allied armies began to cross the Rhine at numerous points, further balloon protection was called forward to protect in turn the Wesel, Kanten, Rees, Wallach and Emmerich bridges. The speed with which the balloon units were deployed to each new area was made a matter for congratulations by the various Army Groups which they were supporting, and particular praise was given by the American armies concerned. In all, the whole of No.974 Squadron, "A" Flight of No.992 Squadron, 'B' Flight of No.976 Squadron and 'B' Flight of No.997 Squadron were withdrawn from the Antwerp barrage to protect the Rhine, the balloons remaining in the Scheldt area being resited to afford the maximum protection possible to the port.

Disbandment of Continental Balloon Units.

2nd TAF/ 30335/ Ops. Reg. Enc.64A.

With the cessation of the V-bomb attacks upon Antwerp, No.980 Squadron was no longer required as a reserve, and on the 16th April, it was agreed to disband the unit, many of its personnel having already been withdrawn to augment the Rhine barrages.

By the 27th April, Headquarters, 2nd Tactical Air Force, agreed that there was now little risk of enemy mine-laying and that the Scheldt barrage was no longer required. The Naval authorities gave their approval and Supreme Headquarters gave the necessary authority for the Scheldt barrage to become non-operational with effect from the 30th April. On the 1st May, the few balloons still flying in the Rhine area were also withdrawn. There being no further use for balloons on the Continent, Headquarters, 2nd Tactical Air Force, formally applied for authority to disband the two L-Z squadrons and two of the port squadrons, retaining the remaining four port squadrons against a possible commitment at the northern ports. Before the arrival of the necessary authority, the German army had surrendered to the Supreme Commander on the Continent.

It was subsequently agreed that Nos.965,967,976 and 991 Squadrons should be disbanded with effect from the 20th May, followed as soon as possible by the remaining balloon units, personnel being returned to the United Kingdom as soon as shipping space was available. During June, personnel of all balloon units on the Continent, including Headquarters, No.159 Wing, were returned to the United Kingdom and dispatched to

/the Royal

the Royal Air Force Stations at Great Sampford and Fairlop, where they were re-allocated and dispersed as required to other Commands.

The Balloon Units' "glorious hour" was over - they had carried out their part in the invasion of the Continent and the conquest of Germany with efficiency and enthusiasm, and if their role was unspectacular, and as with all forms of passive defence, at times seemed unnecessary, it was agreed by all with whom they worked that their morale was high and their administration excellent. In addition to their normal duties the balloon operators acquitted themselves well in the many and varied tasks they were given, from the clearing of the invasion beaches to the ferrying of vehicles across the Rhine.

/SECTION 31

SECTION 31

OPERATION 'DIVER'

Preliminary preparations for the "Crossbow" curtain barrage formed an essential part of the major re-organisation which took place in Balloon Command in 1943 and 1944, and as such have already been described in some detail. (1)

Throughout the greater part of the War, balloons had been flown only as a deterrent to enemy aircraft; reliance being placed mainly upon their moral effect. The enemy pilot knew where he might expect to find them, and generally speaking showed a wholesome respect for them. In the proposal to use balloons as part of the planned defences against the pilotless aircraft their deterrent effect would be entirely absent; they would be a physical barrier and their effectiveness would become purely a question of mathematical probability of impact.

Before proceeding with the story of the balloon defences in action against the flying bomb, it is considered advisable to reiterate certain of the preparations in order that the difficulties which confronted Balloon Command may be outlined in their true perspective.

Planning Defences Against Pilotless Aircraft

AHB/IID/34/4/27A
~~KBO/52315~~
Ops/I-
Enc.1A

Early in December, 1943, the Air Officer Commanding, Air Defence of Great Britain, was informed by the Air Ministry that Germany was actively engaged in research on a pilotless aircraft, and that the enemy were contemplating its use as a weapon of attack against this country. At that time it was thought possible that the enemy could make sufficient advance with their new weapon to be able to launch it against London by January, 1944. Possibilities of defence measures were investigated with all speed, and at a preliminary meeting held at Headquarters, Air Defence of Great Britain, on the 11th December, 1943, it was agreed to explore a proposal to form a 20-mile long protective curtain of guns, searchlights, and balloons to the south and south-east of London, so sited as to cover the majority of the anticipated lines of approach. As far as balloons were concerned, it was suggested that they should be sited on the high ground of the North Downs in order to take advantage of the extra height so provided.

Headquarters, Balloon Command, in consultation with the Directorate of Scientific Research of the Ministry of Aircraft Production, then considered the density of siting desirable and mathematical impact probabilities obtainable from varying densities of balloons, provided that the aircraft approached at a height not in excess of 5,000 feet. It was calculated that the provision of a curtain 20 miles long and approximately 1½ miles deep formed of 500 balloons, would result in a 10% mathematical probability of impact.

Ibid.
Encl.4A

The reduction of Balloon Command's personnel from 30,000 to 28,000 was, however, already in progress, and from this reduced target figure the additional requirements for 'Overlord' had also to be found. It was anticipated that 500 balloons could, without interfering with 'Overlord' preparations, be

/provided

(1) See Section 28.

provided for a curtain barrage by the elimination of thirteen barrages in the Northern, Midlands and South Wales areas. Assuming that an operational control was not imposed, it was thought possible to fly two L-Z Balloons with only one more than the standard L-Z crew (two N.C.Os and seven aircraftmen). Each additional 50 balloons flown in excess of 500 would increase the chance of impact by 1 per cent but this number could only be found by withdrawing a further 25 Air Force manned balloons from the remaining static barrages.

As the major threat appeared to be in the London area, the greater portion of the defensive weapons were to be allocated to this area; threats to such other areas as Bristol and Southampton were covered only by additional anti-aircraft guns and not by additional balloons. The Air Officer Commanding, Balloon Command decided, therefore, that an immediate reconnaissance should be carried out to the South East of London for the siting of 500 balloons. This was a tremendous undertaking, and in view of the extreme urgency of the matter, No.30 Group (in whose area the barrage would be) was assisted by staff officers from other groups. The 20 mile belt was divided into four sections of approximately 5 miles by 3 miles, each reconnoitred by two officers. The reconnaissance, commenced on the 16th December and was completed by the 22nd December, siting being made on a gridded basis to ensure maximum protection against frontal attack in a 20 mile arc spreading from Gravesend to a spot approximately 2 miles East of Caterham.

Administrative headquarters would be required for each squadron, and a base was needed for these headquarters in the form of a Balloon Centre. It was therefore proposed that the Royal Air Force Stations at Biggin Hill and Gravesend should be used as balloon centres for the period of development, where all administrative services - accounting, equipment, meteorological, catering etc. - could be provided.

ibid. Enc.30A.

A detailed plan for the defence of England against pilotless aircraft was put forward to Headquarters, Allied Expeditionary Air Forces by Headquarters, Air Defence of Great Britain on the 2nd January, 1944. This included the balloon defence plan already proposed but reduced the number of balloons to 480 to avoid interference with the Royal Air Force Station, Kenley. The balloons were to be rigged for Centre Point mooring(1) and the space between cables was to be approximately 66 yards on the grid. Assuming enemy aircraft to be flying below 4,500 feet and allowing for nomal balloon casualties, this provided a 9-10 per cent impact probability. The number of personnel needed to provide this degree of protection was assessed at 4,000 all of whom could be found from the proposed reductions in static balloon defences already before the Chiefs of Staff for approval. Provided that all possible assistance and high priority could be given by the Air Ministry in the preparation of sites and the provision of accommodation and communication facilities, it was estimated that the operation of this plan could commence within three weeks of receipt of instructions and that a further three weeks would suffice to complete deployment of the 480 balloons.

Preliminary preparations for "Crossbow" barrage

Whilst this plan was receiving the approval of higher authority, the whole of Chelmsford barrage was rigged for

/Centre Point

(1) See Appendix 'H'

Centre Point mooring in order to gain further experience with this type of mooring.

Preparatory work to secure complete mobility had been already undertaken in the barrages proposed for elimination. Removal of all static winches from concrete bearers and their mounting on trailers was carried out in anticipation of possible deployment. Where squadrons included Women's Auxiliary Air Force sites, airwomen balloon operators had to be withdrawn to other static barrages and replaced by airmen; the nature of the country and the conditions of accommodation in the proposed curtain barrage area being such that airwomen could not be employed on sites or at Field Headquarters.

ibid. Enc.36A. On the 19th January, 1944, the Air Ministry gave authority for the elimination of 422 balloons from the Northern, Midlands and South Wales barrages, and for the holding of seven squadrons with a total establishment of 480 L-Z balloons, together with personnel, mechanical transport and equipment for two new balloon centres, for "a possible new commitment", viz: defence against pilotless aircraft. At the same time approval was given for the formation of eight port balloon squadrons and seven beach balloon units (totalling 525 Mark VI balloons) to meet requirements for the 'Overlord' operations. The South Wales barrage was to continue to fly on a temporary basis in order to protect the activities of the United States Army at the ports of Cardiff, Swansea and Newport.

ibid. Enc.43A. On the 1st February, authority was given by the Air Ministry for the completion of all administrative arrangements in connection with the deployment of the balloon curtain, although for security reasons no actual move of units into the area was to take place until receipt of further instructions. Immediate action was taken by Headquarters, Balloon Command to put these arrangements in train. Representatives visited the Royal Air Force Stations at Biggin Hill and Gravesend to arrange accommodation for the new centres. There they met with their first setback. The stations concerned had not been advised of the part they were to play in the 'Crossbow' plans and the

ibid. Enc.48A. squadrons in possession of the airfields (both of which were fully operational) were not scheduled to move to advance airfields until April, whereas the two balloon centres were scheduled to be in full operation by the 23rd February. Moving the fighter squadrons whilst retaining their operational status was no easy task. Meanwhile, the problems of sharing office and equipment accommodation, added to the shortage of available W.A.A.F. accommodation, made many difficulties, but in spite of the general inconvenience caused to both sides sufficient facilities were obtained to proceed with the formation of No.22 Balloon Centre at Biggin Hill and No.23 Balloon Centre at Gravesend after an initial delay of three days. Preparation of squadron and site accommodation was also begun with a high degree of priority afforded to the works services required.

Defence was not the only arrow in the quiver of our plans against the pilotless aircraft. All through the winter of 1943 and the spring of 1944 extensive air reconnaissance was carried out over the coastline of France in an endeavour to discover all the firing points being erected from which the enemy weapons were to be launched. As these sites were discovered, so the Royal Air Force and United States Bomber Commands attacked them persistently and with great success. By the early spring of 1944 it was evident that the Germans were abandoning work on their original and elaborate firing points and were erecting new sites of a far simpler and less conspicuous type. This meant that the attack anticipated early in 1944 was postponed, but only for as long as the Allied bombers could destroy the sites in pace with their erection,

/and

and in this respect their task was made more difficult as the new firing points were very thoroughly camouflaged.

ibid.
Enc. 51A.

Consequently, the Vice Chiefs of Staff at their meeting held on the 3rd February were considering the possibility of simultaneous deployment of guns and balloons for both 'Overlord' and 'Crossbow' commitments. They ruled that whilst priority should be given to training and deployment for the former commitment, it might be necessary to divert certain 'Overlord' commitments to meet the threat of pilotless aircraft. Administrative arrangements in this connection were therefore to be completed by the 26th February to such an extent as to make full deployment possible within eighteen days of receipt of an order. By careful planning Headquarters, Balloon Command would be able to meet both commitments but, if simultaneous deployment was required, the balloons flying in South Wales to protect the 'Overlord' preparations there, would be required to move to the curtain barrage area. The total number of balloons flying in such circumstances would be greater than otherwise anticipated, thus resulting in a greater use of hydrogen.

Headquarters, Balloon Command were therefore requested to investigate the supply of hydrogen and cylinders to ascertain whether sufficient would be available in the event of a simultaneous deployment. The result of the investigation showed that as far as could be judged from estimation of possible casualties in the curtain barrage the two commitments could be met concurrently and, in addition, that the static barrages could be maintained in operation with existing supplies of hydrogen, but that there was some risk of delay in replacing casualties as a result of shortage of cylinders.

Administrative arrangements went ahead throughout February and on the target day, the 26th February, Headquarters, Balloon Command were able to report that their arrangements were completed. Nos. 22 and 23 Balloon Centres had been formed and moved to their new locations, instructions had been issued to squadrons in anticipation of deployment and a number of hydrogen trailers were already parked at the Balloon Centres ready for immediate use.

However, the enemy threat to London did not materialise during the next three months and the time was utilised in preparing sites, making central anchorages, cutting access and approach roads, completing Centre organisation and gathering together all necessary equipment. Training in Centre Point mooring was given to crews, and everything made ready to make possible a move at forty-eight hours notice.

The squadrons, remaining non-operational in their own areas with the exception of South Wales, were destined to have a long and weary period of inactivity, which presented a problem no less difficult than that of the preparatory rush to achieve a state of readiness, and wherever possible, personnel were loaned to other Commands whilst the order to deploy was awaited.

D-Day for 'Overlord' arrived and our defences were concentrated on the ports from which the Allied invaders sailed. It seemed as if the enemy would have to give his full attention to the repulsion of the attack upon the shores of Normandy and that all our preparations to meet the onslaught of Hitler's secret weapon had been in vain. But on 14th June, the enemy activity reports contained that information that "it is believed that the enemy used pilotless aircraft against this country during the night of the 13th/14th June." On the 15th June, there were further similar attacks on London and it was then confirmed that these were made by the long awaited secret weapon - V.1. - the pilotless aircraft, or the Flying Bomb as it was to be known. Operation 'Diver'(1) had commenced.

ADGB/TS37573/
Ops. 5B.
16.6.45

In the early hours of the 16th June, 1944, the signal to deploy the anti-DIVER Barrage was despatched to all formations concerned.

The Anti-Diver Barrage - Phase I

With instructions to deploy the anti-Diver barrage a request was sent to all formations to accelerate deployment in order to become operational as quickly as possible.

AHB/IID/34/4/27(A).
~~KBC/52345/Ops/X.~~
Enc. 76A

The Cardiff, Swansea, and Newport balloons which were still flying on receipt of the order, were deflated and rendered non-operational by 14,00 hours on the 16th June, and shortly afterwards the hundred crews which were to move from South Wales had packed their balloons and equipment and started on their 250 mile journey. Convoys from the North as far away as Glasgow, from the Midlands and the West country all converged on the North Downs,(2) and crews deployed to the sites already prepared. The speed of deployment far exceeded expectations - the operation, planned to take eighteen days and which it was thought could be completed in nine to ten days as an urgent requirement, was actually accomplished in five days and reflected great credit on the carefully planned organisation.

Balloons that arrived on the 16th were inflated on their sites but not flown until navigational warnings could be issued to all flying units, which step was taken on the 17th June. Thirty-nine balloons were operational on the 17th, 160 on the 18th, 192 on the 19th, 344 on the 20th, and the complete barrage of 480 balloons was flying by the evening of the 21st June - a highly creditable performance.

On the 18th June, instructions were given by Headquarters, Air Defence of Great Britain, that the Norwich barrage (No. 951 Squadron) was to be withdrawn from Norwich to stand by for the purpose of providing reserve personnel and equipment for the Anti-'Diver' barrage. Their balloons were deflated and rendered non-operational by 15.30 hours on the 19th June, and they reformed as a 40-balloon squadron and moved to Weybridge (No.954 Squadron) ready to deploy at thirty-six hours' notice.

/When planning

(1) The defence against the Flying Bomb had been given the code name of "DIVER", whilst the attacks on the launching sites retained the name of 'CROSSBOW.'

(2) Plans of each phase of deployment are at Appendix "K"

When planning the anti-Diver barrage, the Directorate of Scientific Research had recommended that an unarmed cable would probably be effective against the flying bomb and accordingly the squadrons deployed flew D.P./R. links (Mark II), complete with parachute bag, taken from the units' existing equipment. The first impacts by flying bombs against these unarmed cables caused the initial opinion to be revised and on the 18th June the decision was made that cables should be armed with one D.P./R. link and one D.P. Link per cable. Authority was therefore given for the disarming wherever necessary of any L-Z barrage in Great Britain to provide the armament needed for the anti-'Diver' barrage. D.P. Links were taken from the London squadrons, which were authorised to revert from series arming to single arming, and thus initial equipment and a reserve of D.P. Links were provided for the anti-'Diver' barrage. The work of arming the cables commenced on the 19th and was completed by the evening of the 21st June. Thus by the evening of the 21st the balloon belt, as originally planned, was in full operation with armed cables and with a reserve of balloons and crews.

ADGB/S.37802/ Ops.5A 19.6.44.

AHB/II/D/34/4/27(8) KBC/52315/ Ops./II Enc.18A.

In front of the balloons the anti-aircraft gun belt stretched from Maidstone to East Grinstead and outside this belt and towards the French coast, fighter aircraft were in operation. The flying bombs came in over the sea at a height far less than had been originally estimated and those which got past the fighter defences flew over the gun belt at an average of 2,300 feet and sometimes as low as 1,000 feet. This presented the gunners with considerable problems, the height being insufficient to obtain good results from the heavy guns whilst being too high for the light guns. This factor, together with the scale of attack during the first few days brought the realisation that the balloons could play a larger part, and plans were conceived for the thickening of the barrage to a total of 1,000 balloons.

Anti-'Diver' Barrage - Phase II

AHB/II/D/34/4/27(8) KBC/52315/ Ops/II Enc.4A.

On the 20th June, proposals were put forward by Headquarters, Balloon Command, for an increase in the scale of the anti-'Diver' balloon barrage. It was considered that an additional 520 balloons could be provided, together with a reserve of balloon equipment and hydrogen as backing, by the elimination of most of the static barrages and the reduction of the remainder to a token force. The question of adequate reserves of balloons and hydrogen was an important one. At this time, the wastage on balloons in the curtain barrage was a matter for conjecture, but it was certain that every flying bomb destroyed by impact with a balloon cable would result in a drifting balloon which might, or might not, be recoverable or repairable. Since the object of the barrage was to catch as many flying bombs as possible, it appeared to be essential to have a far larger reserve than the normal percentage required for backing, in order to keep the barrage in full and continuous operation.

Provided that high priority could be given by the Air Ministry to the provision of works services, communications and non-technical equipment, and by the Ministry of War Transport to railway facilities for transport of hydrogen, it was estimated that the deployment of an additional 520 balloons could commence within three days of receipt of an order, and be completed in 7 to 10 days.

Approval to the proposals was given on the 21st June. Orders were issued immediately for all balloons at Yarmouth/ Lowstoft, Chelmsford, Canterbury, Harwich, Langley, Weybridge,

ibid. Enc.16A.

/Thames,

Thames, Brockworth, Bristol/Avonmouth, Weston, Yeovil, Falmouth, Newcastle, Sunderland, Billingham, Hull and Forth, to be deflated and packed. In addition, the invasion supply ports of Plymouth, Southampton, Portsmouth and Dover were to be reduced to token barrages, as was London, only the Scapa squadron and existing Mark VI barrages, remaining unchanged. The sites becoming non-operational in the token barrages were to provide additional balloons and mobile winches for the anti-'Diver' defences.

Reconnaissance parties commenced work in the area on the 21st June, and in view of the great urgency, sites were selected on this occasion which were easily accessible and required a minimum of works services. On the 24th the actual move of squadrons to their new sites began. Twenty-five squadrons (including No. 951 Squadron, already standing by in reserve) comprising 520 balloons and 260 crews, were to be deployed as sections, of existing 'Diver' Squadrons, and a further reserve of 104 balloons and 52 crews, together with mobile winches were to be held at various locations in the London area. During the preparatory period, evidence was obtained that enemy flying bomb attacks might come from launching sites further east, and protection to the Thames Estuary was still required. Accordingly the Thames barrage was re-instituted at full strength on the 23rd June, and Admiralty authority given for the immediate withdrawal of 46 balloons from the defence of Scapa.

ibid.
Encs.46A & 56A

By the 1st July, the entire 1,000 balloons had been deployed, and were all operational with the exception of 36 grounded on account of controls imposed in the vicinity of vital points. Although this deployment took nine days as compared to five days for the First Phase, it must be remembered that there was no opportunity for prior planning, and the crews had to be assembled from widely dispersed barrages as far north as Scapa, and as far west as Falmouth. It must also be borne in mind that these crews, unlike those in Phase I, were unfamiliar with the Centre Point mooring.

ibid.
Enc.102A

Up to the 30th June, 53 flying bombs had impacted balloon cables, of which 41 were claimed as destroyed, representing a 77.3% success. This result was sufficiently good for consideration to be given to increasing the density of the barrage still further. (1)

Meanwhile, various requests were being received for the removal or re-siting of individual balloons to safeguard certain vital points. As an instance, a balloon cable near the Inter-Service and Design Establishment at Fort Halstead was struck by a flying bomb which crashed in the Research Station and caused considerable damage. Other vital points such as the Experimental and Research Station at Knockholt, the British Broadcasting Corporation's Station at Tatsfield, and the Northfleet Transformer Station were also jeopardised by the proximity of balloons, and thirty-six balloons adjacent to these vital points were made non-operational pending re-siting. In certain instances moreover, balloons had been sited too near built-up areas. After discussions with the Air Ministry, it was

/agreed

(1) See Appendix "K" for corrected claims.

agreed that in addition to the Experimental Stations, certain town areas should also be safeguarded by the re-siting of balloons so that they would not be nearer than one mile in front of the specified areas and half a mile behind. This decision involved the re-siting of 114 balloons on occupied sites, in addition to the thirty-six already rendered non-operational.

Anti-'Diver' Barrage - Phase III

Before the deployment of Phase II was complete, preliminary plans were being drawn up for a further increase in the barrage to a total of 1,750 balloons. The limiting factor in any such increase was the availability of winches and Royal Air Force balloon operators. Sufficient winches could be obtained from Balloon Command sources to allow the operation of a further 750 balloons backed by a 20% reserve, and by effecting a maximum reduction in Admiralty shore servicing stations, elimination of the remainder of the Scapa barrage, together with further substitution of airwomen for airmen in the token barrages, sufficient Royal Air Force balloon operators could be made available to fly them. The number of balloons flying in the static token barrages, a total of 169, was so small that further reductions there would not materially affect the position.

The duration of operation of this increased barrage was limited however by the balloon supply position. It was estimated that existing stocks, plus output from manufacturers, would allow 1,750 balloons to be flown for 6½ months, allowing for 80% wastage each month. (In actual fact, nearly 80% of the casualties were recovered and repaired, reducing the wastage to a little over 20% each month).

ibid. Enc.86A

On the 26th June, the Air Officer Commanding, Air Defence of Great Britian, gave authority for the deployment of this further 750 balloons, on the assumption that the anti-'Diver' barrage would be required at maximum strength up to the 31st December, 1944. Deployment was to commence on the 8th July, and be completed about the 22nd July. The siting of these additional balloons within the existing perimeter created various difficulties, chiefly the problem of interfering with anti-aircraft gun siting, and the question of entanglement of cables. The reconnaissance was likely to take some days in view of these difficulties, and the units to be deployed had to be newly formed from officers and men strange to one another and drawn from the remnants of squadrons left from the previous deployments.

ibid. Enc. 88A 96A

Accordingly orders for Phase III were divided into two parts; firstly, the assembly of crews preparatory to moving, and secondly, the organisation of crews and their movement into the barrage area. Numbers 1, 3, 11, 12, 13 and 15 Balloon Centres, Nos. 942/3 Squadron (Hull), and 950 Squadron (Scapa) were instructed to provide the highest number of crews possible from their existing resources, and all token barrages were to make the maximum number of sites possible available for airwomen balloon operators, even if these had previously been considered unsuitable for them.

A preliminary reconnaissance of the area revealed the fact that the maximum capacity of the existing barrage area was 1,500 balloons, and the remaining 250 balloons would have to be sited to the west of the existing boundary.

It was obvious that when all 1,750 balloons were deployed, the administrative burdens thrown upon the two centres would be more than their capacity could handle, and that a further centre would be required to deal with the western end of the barrage.

ibid. Enc.110A

/On the 29th

On the 29th June, it was possible to issue instructions for the deployment of the first 250 of the 750 additional balloons. No. 24 Balloon Centre was to be formed and located at Royal Air Force Station, Redhill, and a new squadron of 250 balloons (No. 950 Squadron) was to be based there. This new squadron which was to be deployed as an extension of the existing 'Diver' barrage in an area to the southwest, was formed from the old No. 950 Squadron (Scapa) (now to be disbanded), with the addition of crews from the resources of Nos. 32 and 33 (Balloon) Groups.

Before maximum deployment of Phase III could be effected, it was necessary to secure further mechanical transport, hydrogen and personnel. To provide this, the Mark VI balloon barrage at Dartmouth was scheduled for disbandment and this was accomplished by the 4th July.

ibid.
Enc.105A.

Early in July it was decided to move the entire anti-aircraft gun barrage down to the coast so that the gunners should get an uninterrupted field of vision. By this move, fighters were given complete freedom of action, not only over the sea, but over land between the anti-aircraft gun strip and the balloon barrage. Zones were defined for fighters, guns and balloons to ensure complete co-ordination of action. As far as the balloon zone was concerned, arrangements were made for red "Snowflake" rockets to be fired from selected Royal Observer Corps posts to warn pilots that they were approaching the balloon area, and at night this warning was to be supplemented by exposure of searchlights. In spite of these precautions, however, a number of our own aircraft collided with balloon cables, some with fatal results. At the same time, to give effect to the decision to allow adequate clearance in front of specified vital points, authority was given to extend the balloon barrage area southwards to a depth of 800 yards. Concurrently, an area to the north-west was to be eliminated so that the barrage perimeter took on a new shape at its western end. On the 7th July, orders were issued that certain balloon sites were not to be deployed until a further reconnaissance in the new area could be completed, owing to alteration in the perimeter.

ibid.
Enc.114A.

AHB/IID/34/4/27(C)
~~AHB/52315/~~
~~Ops.III~~
Enc.6A.

On the 14th July the anti-aircraft gun belt took up its new position on the coast, and orders were issued for the deployment of 96 balloon sites in the new southern area, together with the move of 114 sites to the new area from that to be eliminated, making a total of 210 sites in the new south-westerly section of the barrage. Of this total, 182 sites were to be occupied by a new balloon squadron, (No. 970 Squadron) to be formed at No. 24 Balloon Centre (Redhill) from the resources of No. 30 (Balloon) Group.

AHB/IID/34/4/27(C)
~~AHB/52315/~~
~~Ops.III~~
Enc.4A.

ibid.(Pt.II)
Enc.122A.

ibid.(Pt.III)
Enc.20A.
ibid.
Enc.36A.

In order that only a few balloons in the barrage should be non-operational at any one time, the deployment of the whole 750 balloons to their allotted sites was to be carried out before any transfer of sites took place, and at no time were more than 36 balloons to be deflated for the purpose of re-siting. The deployment of the 1,750 balloons was completed on the 21st July, and within the following week, the move of the 114 sites from the north-west of the barrage to the southern perimeter was also completed. By the 27th July, the new pattern of the barrage was complete, but it was not to remain in this form for more than a month, and already plans were in hand to increase it still further to combat the new flying bomb attacks now threatening from the east.

/Operation

Operation and Administration of the Anti-'Diver' Barrage

Before proceeding with the history of the next phase of the anti-'Diver' barrage, it is considered advisable to examine the various operational and administrative aspects of the major deployments which had already taken place.

(a) Barrage Control

In order to obtain all possible information as to the efficacy of balloons as a counter-measure to flying bombs, it was essential to set up a recording organisation to provide the relevant data. Plotting was carried out at Command Headquarters, unilateral lines being provided parallelled from Headquarters, No. 11 (Fighter) Group to five Royal Observer Corps Centres at Watford, Horsham, Maidstone, Bromley and Colchester. The Barrage commander and Barrage Control were located at No. 22 Balloon Centre (Biggin Hill) with sub-control stations at the other two balloon centres in the area. These sub-barrage control stations acted as distributing centres for all operational orders, and were responsible for operational returns from their own areas. In the normal organisation of Balloon Command, a barrage commander was also a centre or squadron commander, but in view of the heavy responsibilities borne by the anti-'Diver' barrage commander, he was relieved of all administrative duties, a separate centre commander being appointed for this purpose at No. 22 Balloon Centre.

(b) Communications

For the original deployment, communications from the sites were envisaged as being by G.P.O. Exchange facilities, but before these could be provided, it became evident that the continuous increase in the number of balloon sites in each area necessitated special communication facilities if the country exchanges were not to be overloaded. Eventually, all sites were linked by a private wire to their Flight Headquarters, up to three sites being on an omnibus circuit. Each Flight Headquarters was provided with an extension to Squadron Headquarters, and then to the appropriate Centre. Private wire facilities were augmented by the provision of Exchange lines to all formations other than balloon sites.

Although in all but the first Phase, deployment was being effected simultaneously with each new reconnaissance, the balloon crews moved on to their sites to find communications already installed in almost every instance. The signals network required for the barrage entailed the installation of some 70 switchboards, 2,000 private lines, and 5,000 miles of cable. There is no doubt that without the co-operation received from the G.P.O. in this matter, deployment could not have been effected so speedily and operational efficiency would have suffered. It is interesting to record that the provision of communications was so difficult a task that the sizes of flights and squadrons and the areas in which they were located were governed, in almost every instance, by the signals facilities available in each area.

AHB/IID/34/4/27(C)
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Ops/III
Enc.26A.

/(c) Armament

(c) Armament

A special staff of armament intelligence officers was provided at an early stage in the development. These officers, working in the field in conjunction with recording officers at Command, investigated all confirmed or suspected collisions. From their investigations it was possible to assess, in some degree, the efficiency of the various types of balloon cable, and armament used during the operation.

It will be remembered that after the deployment of Phase I, each balloon cable was armed with one D.P./R link and one D.P. link. The packs for the 520 balloons of Phase II included this scale of armament with an appropriate reserve, which was provided from the resources of the units transferred to the anti-'Diver' barrage. When the decision was made to increase the barrage to 1,750 balloons, unit resources were no longer able to meet the cable armament requirements and accordingly, on the 27th June, an Armament Servicing Depot was established at No. 3 Balloon Centre (Stanmore). The function of this Depot was to provide serviceable armament equipment for the additional 750 balloons, build-up resources, replace losses, and undertake major work for the units operating in the barrage. All surplus balloon armament was called in to the Depot, some of it far from serviceable, and the Depot was able to repair and utilise it until further supplies were available from production. In this way, sufficient armament was found for the Phase III deployment, after which the depot turned its attention to the servicing of the armament equipment already in use by the balloons deployed in Phase I and II, which was not always up to the standard required to withstand the high speed impact of flying bombs.

It was soon found that where the D.P./R Link and D.P. Link functioned moderately well, flying bombs colliding with the cable were brought to earth in nearly every instance. One difficulty experienced, was the tendency of the cable to pull through the wedges of the D.P. Link resulting in the parachute not being withdrawn and the failure of the armament. Urgent attention was given to this matter by Research and Development Directorates of the Ministry of Aircraft Production, and a new D.P. Link housing was produced by the Martin Baker Aircraft Company. This was submitted to trial by the Balloon Development Establishment during July and survived tests in which normal housings and wedges failed. In view of the urgency of the matter, Service trials were dispensed with and the cables of one of the anti-'Diver' squadrons (No. 945/7 Squadron, Oxted) were fitted with the improved armament on the 11th August. Owing to the dwindling of the scale of attack at the western end of the Barrage, there was little opportunity to test it under operational conditions, however, and before further sets could be produced, attacks had almost ceased.

ibid.
Enc.127A.

Another problem which arose was the comparative failure of the D.P./P. Mark II. The Balloon Development Establishment worked on suggestions to improve

/the link

the link, and as an interim measure, balloons in two squadrons were flown with cables fitted with single ripping link action with an upper and lower D.P. Link. Here again, attacks dwindled before full trials could be made under operational conditions.

(d) Hydrogen Distribution

Preliminary plans for hydrogen distribution envisaged simultaneous deployment of both 'Overlord' and anti-'Diver' barrages, and a disposition of hydrogen facilities was made to cover heavy demands for both operations, as far as the available equipment would permit. As the operations occurred successively and the hydrogen requirements for 'Overlord' were very light, there were no difficulties regarding hydrogen supply in the early stages of Operation 'Diver.' The transport of hydrogen cylinders to the barrage area, however, presented a problem due to the shortage of hydrogen vehicles, and whilst additional vehicles were being drafted into the Command and converted to hydrogen carriers, two mechanical transport companies of the United States Army assisted Dodge vehicles of Balloon Command. To ease the strain on the vehicles and drivers, special trains were arranged to collect hydrogen from the more distant factories at Poole, Weston and Longeaton. These services were synchronised on a regular 4-day turnround. The collection of up to 20,000,000 cubic feet of hydrogen per week worked smoothly throughout the period of operation, but this was only made possible by the closest co-operation of all concerned - the hydrogen officers, the gas factories and the line of communication drivers.

(e) Radio Counter-Measures

When certain weather conditions made it necessary to close-haul the balloons, these conditions also restricted the operation of fighters. The anti-'Diver' barrage was sited within Radar coverage by the enemy, enabling him to be aware of periods when the balloons were close-hauled and thus indicating to him opportunities to increase his scale of attack. Forms of radio counter-measures were therefore investigated by the Director-General of Signals (Air Ministry) and early in July equipment was installed at Dover and Fairlight to jam the enemy Radar stations. These counter-measures were not considered the complete answer to the problem, however, as it was doubtful whether jamming would be effective, and long periods of jamming would give the enemy the opportunity of devising means to overcome it. It was therefore suggested that in bad weather balloons should be replaced by kites fitted with a device to give a Radar response. Tests were carried out at the Balloon Development Establishment but in view of the lack of success with previous kite trials and the fact that, apart from lightning risks, kites were subject to the same weather conditions as balloons, Headquarters, Balloon Command did not favour the operation of any kites in the existing barrage. It was therefore left to the Admiralty, if they so desired, to carry out service trials in the Isle of Grain area as a counter to flying bombs approaching London from the east.

(f) Site

(f) Site Accommodation

As it had been ruled that the anti 'Diver' barrage would be required at least until the 31st December, 1944, it was necessary to consider the question of winter accommodation, instead of the Army-type tents with which balloon operators were provided on the sites. The extensive amount of labour and material necessary for this building programme would be difficult to find, and it was a heavy financial undertaking, quite apart from the disadvantages of moving hutting from one site to another, which would occur upon the move of portions of the Barrage.

The United States Army authorities were approached, and consented to the loan of special "winterised" tentage in sufficient quantities to supply all sites and detached Flight Headquarters for a 1,750 balloon barrage. Distribution of these tents commenced at the end of July, but happily their "winterised" qualities did not have to be put to the test, as the flying bomb attacks ceased before the winter.

(g) The Light-wire Arming Schemes

Owing to the limitations imposed upon any increases in the balloon defences by the shortage of manpower and equipment, it was natural that means of increasing the "impact probabilities" should receive a good deal of attention. The technical 'Crossbow' Sub-Committee of the War Cabinet received many suggestions and inventions, some ingenious but impracticable, others simple and practical. Accordingly it was ruled that the Balloon Development Establishment should examine all practical suggestions and in cases where promise of success appears, experiments were to be carried out in the barrage area. Because of its position on one of the main lines of attack, a flight of No. 958 Squadron, already in the barrage, was selected for this purpose and experiments on the efficiency of light wire assemblies were carried out in situ. For these trials, a section of the Balloon Development Establishment was resident at the Field Headquarters with full powers to experiment with different rigs on all sites in this flight.

At the same time, a number of Mark VI balloon units of No. 85 Group,(1) intended for port protection overseas were standing by at No.6 Balloon Centre, (Wythall). Permission was obtained to deploy these units into an area east of Gravesend not already covered by the curtain barrage, and there to utilise them partly to intercept flying bombs and partly to obtain information as to the effectiveness of a bomb/parachute light-wire arming. If Mark VI Balloons used in this way were proved effective, they would have many advantages over the L-Z barrage in reduced hydrogen consumption, smaller balloon wastage and saving of manpower. The 265 Mark VI balloons were in position by the 24th July, but unfortunately only a limited number of impacts occurred, none of which caused the destruction of a flying bomb.

ibid.
Encl.28A

/Another

Another experiment to increase the impact probabilities was undertaken by the Admiralty, who carried out trials with wire nets strung between two balloons and also with additional light wires suspended from the main cable, but the nets were not a success. Experiments were made with 18 SWG., 15 SWG., and KBIA cables, but it was found that loss of height, handling difficulties and ground obstructions, of which the many high tension cables in the area were the greatest menance, precluded more than one or two wires being added on most sites.

Eventually it was decided to equip each site with an additional 2,500 feet length of KBIA cable, as, on trial this gave the most destructive results within an acceptable distance of impact. The lighter 15 SWG cable gave increased impact probability but a much less destructive capacity. At a later date two hundred sites at the southern extremity of the barrage were fitted with a twin 15 SWG wire assembly, parachute armed, which could be hauled down by power drive from the main cable. However no results were obtained before the main attacks in the area ceased. (1)

The use of these light-wire schemes necessitated the provision of additional anti-lightning precautions, and for this purpose lengths of Summerfield tracking had to be laid between the main balloon winches and the central anchorage on every site, on the basis of one 25-yard length for each additional light wire. During August, 1,374 lengths of tracking were laid by unit labour.

Anti-'Diver' Barrage Phase IV

By 21st August, flying bomb attacks had almost ceased in the area west of a line drawn from the Somme Estuary through Hastings to Caterham, and their renewal in this area was considered unlikely in view of the progress being made by our Armies on the Continent.

It was therefore decided to withdraw all guns and balloons west of this line and to re-deploy them at the eastern end of the barrage in order to stiffen the defences of the area in which attacks were still being made. The Mark VI balloons, flying north and west of Rochester at the eastern extremity of the barrage proper had proved unsatisfactory and were to be replaced by the balance of L-Z balloons being re-sited within the perimeter of the existing barrage. 245 balloons were affected by this re-deployment, 106 moving to the Mark VI balloon area.

Seven days was the period allotted for this move, and on the 28th August, it had been satisfactorily completed and all Mark VI units returned to No. 6 Balloon Centre (Wythall) under 85 Group arrangements. The sites vacated at the western end of the balloon belt were retained, in case it was found necessary at a later date to re-deploy the balloons in this area.

/There being

(1) Full details of the various cable and wire experiments are at Appendix "K".

There being no longer any use for a Balloon Centre at the western extremity, No. 24 Balloon Centre was moved from Redhill to Royal Air Force Station, Fairlop.

The Eastern Anti-'Diver' Barrage

Whilst arrangements were still being made for deployment of the enlarged barrage of 1,750 balloons, plans were already under discussion for the augmentation of the barrage for the defence of London from the east.

AHB/IIJ/30/4/4/27(c)
KBO/52315/Ops/A-III

Enc. 1A

By the second week in July, tracks of flying bombs had been plotted flying west from the Ostend area along the Thames Estuary to London. It was appreciated that as the campaign in Normandy progressed and the Allies began to overrun the sites on the French Coast, the flying bomb attacks would be continued from new sites in Belgium and Holland. An anti-'Diver' barrage was therefore required east of London, but the deployment of any defences there was restricted by the built-up and industrial areas in that part of the country, and by the amount of marshy land in which it would be impossible to deploy either balloons or guns. Nevertheless, it was considered that balloons should be sited west of a line running from Rochester to Thames Haven, and the preliminary reconnaissance showed that 106 balloons could be sited south of the Thames and 307 to the north.

ibid.
Enc. 19A

On the 18th July, a meeting was held at Headquarters, Air Defence of Great Britain, attended by representatives of the Air Ministry, Balloon Command and Anti-Aircraft Command to consider plans which had been drawn up for the eastern defence of London. It was decided that whichever plan was adopted, it would be carried out in two phases -

Phase I - to counter flying bombs launched from Belgium as far north as Knocke.

Phase II - to counter flying bombs launched from Belgium, and from Holland as far north as The Hague (which was considered the limit of effective range of these missiles).

ibid.
Enc. 49A 60A

Anti-Aircraft Command were concerned about the effect of an eastern balloon belt upon their Radar pick-ups, and the consequent interference with existing anti-aircraft defences against orthodox enemy air attacks, and they pressed for the balloons to be moved further east. After further investigation and discussion on this point, on the 11th August it was ruled by Headquarters, Air Defence of Great Britain that as attacks by flying bombs were a reality and orthodox air attack only a threat at the time, the anti-'Diver' defences must be the first consideration and the resultant interference with defences against orthodox air attacks must be accepted.

ibid.
Enc. 32B

Headquarters, Balloon Command had already been instructed to go ahead with plans for the deployment of 400 balloons, and this was followed up on the 20th July by a request from Headquarters, Air Defence of Great Britain to prepare a plan for the deployment of 1,250 balloons in the area bounded by Rochester, Chelmsford, Chipping Ongar and Dartford, making a total of 3,000 balloons employed in an anti-'Diver' role. By the 25th July, Headquarters, Balloon Command had examined the possibility of such a large increase in the anti-'Diver' barrage and submitted a paper to Headquarters, Air Defence of Great Britain setting out the factors limiting the flying of additional balloons, the main one proving a shortage of balloon

/operator

operator personnel. As almost all the resources of Balloon Command were already in the 'Diver' barrage, all remaining static barrages would have to be eliminated, to provide an additional 400 balloons and even then, 310 sites would need to be manned by airwomen there being only sufficient airmen balloon operators in the Command to man at the most 90 additional sites. The employment of airwomen balloon operators would raise difficulties in providing suitable accommodation, particularly for the winter months, a possible loss of operational efficiency and wasteful use of man/woman power. On the other hand, to fly 400 balloons manned solely by airmen would mean bringing back from other Commands 1,300 ex-balloon operators out of the thousands who had been thrown up in previous re-organisations.

To increase the barrage to a total of 3,000 balloons was a far more difficult proposition. In the first place 9,000 redundant balloon operators would have to be recalled from other Commands, all of whom would require at least one week's training before they would be capable of handling balloons efficiently. Moreover, balloons, technical equipment and hydrogen would be needed in excess of any total which could be provided from Command resources. On the supposition that all these difficulties could be overcome by special priorities and urgent provisioning action, it was estimated that deployment of the first 400 balloons could be completed within 7 days of receipt of instructions, but the further 850 balloons would take approximately an additional 30 days to deploy.

ibid. Enc.40A

By the 29th July, 122 flying bombs had operated against London from the east, and the provision of an eastern anti-'Diver' barrage became a matter of some urgency. Headquarters, Air Defence of Great Britain, therefore, requested the Air Ministry to give urgent consideration to Headquarters, Balloon Command's proposals to deploy a further 1,250 balloons at the expense of all remaining static barrages in the United Kingdom. Whilst the Air Ministry was considering the various administrative implications, authority was given to undertake reconnaissance for all sites, but no works services were to be completed pending receipt of specific instructions. Within the area reconnoitred a suitable frontage was to be found for the Admiralty to carry out further trials of its curtain scheme, with wire suspended between pairs of balloons.

ibid. Enc.42A

Throughout August, the problems involved in such questions as the removal of the static defences and the provision of the necessary equipment and personnel to man the eastern anti-'Diver' defences were discussed at a high level, but as the attack from the east was not as heavy as had been anticipated, no urgent action was taken to deploy the barrage. In addition, the pressing need of manpower for offensive operations, the growing effectiveness of the anti-aircraft gun belt, and the low collision ratio of balloons justified this delay.

Nevertheless on the 1st September, approval by the Air Ministry was given for all preliminary administrative arrangements to be made for 800 balloons of the eastern anti-'Diver' scheme, although no re-allocation of man-power or deployment of such balloons was yet to take place. This could have been effected by the move of 800 balloons from the western end of the barrage where attacks had almost ceased. By this time, however, the rapid changes in the strategic situation on the Continent caused the Air Officer Commanding, Air Defence of Great Britain to request re-consideration of this decision, as it now seemed that enemy attacks from the east were unlikely to

ibid. Encs.87A 89A

/develop

ibid.
Enc.92A

develop further and the Works and Signals implications of such a move were of some magnitude. By the 8th September, it was obvious that the rapid advances on the Continent cancelled the threat of further flying bomb attacks from the east, other than from airborne launchings, and the Air Ministry therefore cancelled all action planned for the eastern barrage, as well as authorising relinquishment of sites on the western section of the southern anti-'Diver' barrage.

Results of Anti-'Diver' Balloon Defence

From the deployment of the initial phase on the 17th June to the 4th September, when attacks virtually ceased in the anti-'Diver' area, 1,937 flying bombs had entered the balloon belt when balloons were operational, in addition to 333 when the balloons were grounded for bad weather. Of these, 407 impacted balloon cables, of which a total of 279 was destroyed. Thus 68% of the flying bombs which collided with cables were destroyed, though only 14.4% of the flying bombs entering the barrage were destroyed. To achieve these results a daily average of 1,354 balloons had been flown for 81 days, and 2,811 balloons had become casualties through natural causes and enemy action. (1)

Form 540

When a flying bomb collided with a cable it seldom fell on the same site, but frequently became a source of danger to an adjoining site. Despite the fact that the balloon sites were located in the main bomb lanes, there were few serious casualties, although on the 18th June, a bomb fell on a site, injuring three of the crew who had just arrived and had not yet inflated their balloon. In August three fatal casualties were caused by two incidents where balloons fouled the high tension wires, but no fatalities were the direct result of a flying bomb exploding on a site. One flying bomb fell on the airfield at Biggin Hill killing three airmen of Balloon Command, asleep in a Nissen hut.

The 2nd and 3rd August provided the most exciting and heavy days in the balloon belt. On the 2nd August ninety-five flying bombs entered the barrage, of which only eight impacted cables and five of these crashed. The 3rd August was a day of triumph; of fifty-eight flying bombs that entered the barrage thirty-one collided with balloon cables, twenty-four and a half of which were credited to Balloon Command.

Several balloon sites came in for more than a fair share of the 'kills.' One site which claimed three in eight days, was situated at the basis of an inverted 'V' the arms of which were regular Flying Bomb runs. After flying the balloon for a week without incident, late one evening the cable stripped the starboard wing from a passing bomb which came to earth half a mile away beyond the adjacent village, where it exploded and did little damage. The lost balloon was replaced and three days passed without further incident. At midnight on the third day, a flying bomb severed the cable, uprooting the central anchorage by the force of the collision. The anchorage was repaired and replaced, another balloon was flown and three days later a flying bomb was seen heading straight for the site. It struck the cable and landed on an adjacent site without injury to the occupants. The balloon, which had broken loose, was recovered and repaired in this instance.

/Another

(1) Later investigations showed that these totals were slightly in excess of authenticated final figures; see Appendix "K".

Another site which claimed three 'kills' in as many days, included in their bag an unexploded flying bomb, a trophy which was removed by experts for minute inspection, and which supplied valuable information to Intelligence Branches at the Air Ministry.

Disbandment of anti-'Diver' Barrage

On the 8th September, 1944, when the Air Ministry cancelled the Eastern anti-'Diver' barrage, Mr. Duncan Sandys, M.P., Chairman of the 'Crossbow' War Cabinet Committee, gave a statement to the Nation, through the Press, stating that but for the few last shots the Battle of London was over.

He paid generous tribute to the various Services who had contributed to the defence, although by comparison with the praise heaped upon the fighter aircraft and Anti-Aircraft Command, balloons came in for a very small share. As the last line of defence they could not be expected to contribute a large proportion to the total of flying bombs destroyed, but their successful accomplishments in the many major deployments undertaken, the new principles of balloon defence learned, and the new methods of flying mastered, were deserving of high praise, which would have been accredited to them by anyone who appreciated the magnitude of these tasks. In actual fact, balloons destroyed 15% of the flying bombs which entered the barrage over the whole period, as compared with the 46% brought down by the combined efforts of guns, fighters and balloons.

Headquarters, Air Defence of Great Britain now had to consider the deployment of defences to meet the threat of attack from air-launched flying bombs. It was considered highly unlikely that more than thirty to forty flying bombs per day could be launched in this manner, owing to the shortage of enemy aircraft for the purpose, and that even so, the flying bombs were likely to be extremely inaccurate. In view of the anticipated small scale of attack no balloons were required to cover this threat. In addition, owing to the continually improving situation on the Continent, most of the vulnerable areas in the United Kingdom were now out of reach of orthodox enemy aircraft other than heavy bombers. Permission was therefore sought from the Air Ministry to disband the anti-'Diver' Balloon Barrage and the static token barrages of London, Dover, Southampton, Portsmouth, Plymouth and Thames, and to proceed with the elimination of all balloon sites.

ibid. Encl.98A. On the 19th September, the Chiefs of Staff approved a recommendation that resources and personnel of Balloon Command should be retained in sufficient strength to deploy and maintain a barrage of 800 balloons to meet any possible future flying bomb attacks, but that with this exception all balloon defences could now be disbanded. Accordingly on the 23rd September, instructions were sent out by Headquarters, Balloon Command to all anti-'Diver' formations instructing them to become non-operational forthwith, and for balloons to be deflated and packed as soon as weather conditions permitted. All experiments in armament and radar counter-measures were cancelled, but a reconnaissance of an area north of the Thames was carried out, so that the possible new barrage of 800 balloons could be deployed at short notice if necessary.

ibid. Encl.101A.

ibid. Encl.105A.

The personnel of all anti-'Diver' units were then dispersed, with the exception of those required for the 800 balloons, who were moved to No.24 Balloon Centre (Fairlop) there to remain pending deployment or disbandment.

It is worthy of mention that the men of Balloon Command worked in the 'Diver' Barrage area for several months before disbandment, making good any roads, fences and fields damaged by the deployment and assisting Lands Officers in settling the claims on some 3,000 sites, all of which had been requisitioned on occupation. The inhabitants of Kent had helped the men in the task of rapid deployment, and it was the wish of Balloon Command that they should be repaid by the restoration of their land in good condition.

AHB/IID/34/4/27(D)
~~KDO/52315/Ops/IV~~
Encl.4A.

In view of a possible flying bomb attack against the Midlands from German-held Dutch islands or Norway, the reserve barrage was retained until January 1945. On the 11th January, however, the Chiefs of Staff gave authority for the disbandment of this reserve barrage and the final remnants of the anti-'Diver' Barrage were dis-established and disbanded.

/SECTION 32

SECTION 32

DISBANDMENT OF BALLOON COMMAND

The First Stage

The withdrawal of the anti-'Diver' Barrage saw what was virtually the end of the need for balloon protection over these islands. True an occasional flying bomb launched from a carrier aircraft somewhere over the North Sea made its appearance, but the main method of direct attack, now employed by the German High Command against this country was the new V.2 explosive rocket. There were of course rumours and threats of new terror weapons in plenty, but whether or not these would follow the line of the V.1 was difficult to foresee. Whatever "rod in pickle" the enemy had it was not possible or reasonable in view of our expanding fronts, to earmark large forces for static defence against possibilities that were not at all likely to be retained.

Now on the defensive, the Luftwaffe, overwhelmed by the resources of the combined Royal Air Force and United States Army Air Corps, was unlikely to return to the attack. Nevertheless the possibility of a large-scale last minute attack, launched with the idea of boosting German morale, could not be ruled out. Furthermore the inventive genius of the German scientist in the field of terror weapons was well-known. It was not surprising, therefore, that the Chiefs of Staff agreed that, although balloon defences in the United Kingdom were not now required, an organization should exist whereby the rapid deployment of a substantial balloon barrage was possible if the need should arise.

If the barrages were deflated and personnel dispersed a sudden emergency would find our defences in a state that would require several months to remedy. Our balloon defences had been twice previously reorganised (1) and at this time stood well below our peak strength of 1941. Nevertheless it was felt by all concerned that the time had arrived when we could safely begin to disband much that had been so vitally necessary only a few months ago.

AHB/5D/34/4/28
~~KBC/S.52726/~~
~~Ops.Enc.3A.~~
~~22.9.44.~~

The Balloons Deflated

On the 22nd September, 1944, Headquarters, Air Defence of Great Britain signalled instructions to Headquarters, Balloon Command to deflate all balloons. The day of the United Kingdom Balloon Barrages which had remained fully operational since the now distant 1st day of September 1939 (2) had passed. The final state of the barrages at the time of this order was:-

ibid.
Encl.10A.
24.9.44.

	Barrage	No.of Balloons
(1)	Anti-'Diver'	1,750
(2)	London	50
(3)	Thames	20
(4)	Dover	14
(5)	Portsmouth	30
(6)	Southampton	22
(7)	Plymouth	33
		1,919

ibid.
Encl.13A.

For various reasons, i.e. adverse weather conditions in some areas, and the need to deflate and pack balloons in dry weather, all barrages were not finally deflated until 1500 hours on the 26th September 1944.

/Disbandment

(1) See Sections 18 and 28.

(2) Initial order to fly Balloon Barrages in No.30 Group took place at 1700 on 1st September 1939. See Part I, page 192.

Disbandment commences.

On the 29th September 1944, Headquarters, Balloon Command issued detailed instructions on the action to be taken by all formations within the Command. The order provided for the retention of certain units to be held in reserve for possible deployment in an anti-'Diver' Barrage role. This was in accordance with the recommendation approved by the Chiefs of Staff, who at their 311th Meeting on the 19th September 1944, decided that the resources, personnel and equipment required to maintain a barrage of 800 L-Z balloons (1) should be held against a possible emergency. This barrage if required, would most likely be needed in the area East and North-East of London. It was to be fully equipped and ready to deploy and become operational without delay.

Apart from this commitment the intention was to disband the whole of the Command, except a small nucleus balloon unit with which it was intended to preserve on a permanent basis the "specialised functions and experience of Balloon Command." The 800 L-Z Balloon anti-'Diver' Barrage was to be again reviewed by the Chiefs of Staff within the next few months but, in the meantime, Headquarters, Balloon Command set about its establishment. The units selected to provide the Barrage were placed under the administrative control of No.24 Balloon Centre at Fairlop and were accommodated in winter quarters as follows :-

AHB/IID/34/5/16(A)
~~KBC/S2723/Org.~~
Enc.3A
29.9.44.

Unit	Location
No.970 Squadron	Marden Park Norbryght
No.945/7 Squadron	Great Sampford
No.958 Squadron No.951 Squadron	Southend
No.953 Squadron	Chessington

It was decided, in addition to the reserve anti-'Diver' Barrage, to retain the London squadrons on a greatly reduced scale to man the 'Supplementary Warning Apparatus sites located in the London area. These sites numbering 71 in all were manned as under :-

Unit		Sites No.	
No.901 Squadron	1 to 3	}	Consolidated into No.
No.902/3 "	4 to 16	}	901/5 Squadron.
No.904/5 "	17 to 33	}	
No.906 "	34 to 48	}	Consolidated into No.
No.907/8 "	49 to 62	}	906/10 Squadron.
No.909/10 "	63 to 71	}	

All were equipped to a reduced scale necessary for the units to function.

Battle Stations Evacuated.

The first phase of the disbandment covered several months. There was much work to be done before personnel could be released for other duties. Most of the units concerned were at anti-'Diver' sites where many works services had been carried out. These sites, for the most part, agricultural land, were again urgently required for that purpose.

/Before they

(1) See Section 31, page 540.

Before they could be handed over much work was necessary to reinstate the land, ready for the plough. Headquarters, Balloon Command, therefore, issued an order that before leaving anti-'Diver' positions all possible re-instatement work was to be carried out. Each squadron was ordered to leave a rear party which would include two officers. The sites would be cleared to the satisfaction of the Lands Officers and a written confirmation that the area was properly cleared was to be obtained from No.22 Balloon Centre before final withdrawal.

Storage Arrangements.

The disbandment of the squadrons due for elimination commenced with the order to deflate the barrage. Personnel of non-balloon trades, not required for the work of elimination, were put up for disposal. Equipment was stored at certain stations under Balloon Command which issued very precise instructions on this matter. It was obvious that such a large quantity of equipment could not be absorbed suddenly by existing Maintenance Units, who were fully occupied in handling the output of manufacturers, now at its peak. Headquarters, Balloon Command, therefore, were required to make provision for storage within their own resources. In this respect the Command was fortunate in retaining many balloon centres, with their many large hangars and workshops, which would, upon the disbandment of squadrons, become redundant. These were used to store the various types of equipment now thrown up, and arrangements were made for Maintenance Command to take over the stations as sub-depots to existing Maintenance Units. In addition, Headquarters, Balloon Command, took over from Air Defence of Great Britain the Royal Air Force Station at Zeals, for this purpose.

The final arrangements for storing equipment were :-

(a) To :- Nos.3,11,13,15 Balloon Centres,
Balloons and Balloon Technical Equipment.

(b) To :- No.2 Balloon Repair Unit Kidbrooke, and R.A.F. Station Zeals.
Barrack and Office Equipment.

(c) To :- Nos.3 and 11 Balloon Centres.
Clothing.

(d) To :- R.A.F. Station Cardington (not taken over by Maintenance Command).
Winches.

(e) To :- R.A.F. Cardington and No.2 Balloon Repair Unit.
Dodge Hydrogen, L of C. Tenders, Trailers and Cylinders.

In order that the work of storage should be carried out in a manner acceptable to Maintenance Command, the Senior Equipment Officers responsible for the task at the respective Balloon Centres were instructed to contact local Maintenance Units and to co-operate fully with them.

The clearance of sites and subsequent storage of equipment called for a considerable amount of mechanical transport. This, owing to the extreme shortage at the time came entirely from the resources existing within the Command and resulted in all Units remaining complete mechanical transport sections.

/Disposal of

Disposal of Hydrogen Factories

Of the many hydrogen factories and silicol plants established throughout the United Kingdom a number had been put on a care and maintenance basis at various dates. Those remaining at this time were treated as follows :-

Hydrogen factories :-

Cambridge, Bedford, Cardington, Wellingborough, Chelmsford	To remain pending a decision on the 800 L-Z Balloons commitment.
Poole, Runcorn, Billingham, Dowlais	To remain for sundry commitments of the Directorate of Compressed Gasses.
Long Eaton, York, Weston, Torquay, Swindon, High Wycombe, Epsom, Harpenden	To close down.

Silicol plants :-

"S" Plant, Maidstone; "R" Plant, Fareham; "Q" Plant, Scapa	reduced to a care and maintenance basis.
No.4 M.H.S.U., Rye	Dis-established.
Nos.5, 6, and 7 M.S.Us.	Remained at Cardington pending possible overseas requirements.

Treatment of Mechanical Transport

As squadrons completed the disposal of their equipment, and mechanical transport became surplus to requirements, Headquarters, Balloon Command, issued instructions that, before being transferred from the Command all vehicles should be made fully serviceable.

To enable this to be carried out efficiently and on an economic basis, seven Mechanical Transport Repair Units were established within the Command. To each, certain types of vehicles were despatched for repair and overhaul as shown :-

Unit	Location	Vehicles handled
No.60 M.T.R.U.	Cardington	All Winches.
No.61 M.T.R.U.	Wythal	3-ton Chassis.
No.62 M.T.R.U.	Titchfield	3-ton Chassis.
No.63 M.T.R.U.	Pucklechurch	5/10 cwt vans and staff cars.
No.64 M.T.R.U.	Stanmore	15 cwt vans, and all motor cycles.
No.65 M.T.R.U.	Kidbrooke	All Dodge Tenders.
No.66 M.T.R.U.	Chessington	Pedal cycles.

/Disposal of

Disposal of Personnel

During the anti-'Diver' operation steps were taken to release to other employment many of the W.A.A.F. balloon tradeswomen absorbed into the Command since 1941. When the decision to disband Balloon Command was taken this policy was not interfered with in any way. No airwomen of balloon trades were retained to assist in the work of disbandment.

From the start of the scheme certain non-balloon tradesmen became redudant immediately and steps were taken to release these to other commands. The clearance and reinstatement of balloon sites, and the clearance and storage of equipment was undertaken largely by the now mis-employed balloon operator. Eventually all were interviewed and their wishes in regard to future Air Force employment ascertained. They were subsequently posted for duty in other trades without remustering, pending a decision regarding the terms of redundancy.

Headquarters, Balloon Command, anticipated that some considerable time would elapse before all redundant personnel could be absorbed, and as it was necessary to keep morale to the highest standard during this interim period, a scheme to keep all airmen fully employed was formulated.

All Balloon Centres and Squadrons were instructed to institute fully comprehensive courses in educational, physical and recreational, and military and weapon training. Educational training included a wide range of handicrafts, lectures, films, discussion groups and formal classes in many general subjects. Education Officers were fully employed, and ably assisted by personnel holding suitable qualifications in various subjects who volunteered for such duties. The syllabus of military and weapon training included handling of rifle, bayonet, grenade and sten guns - application of fire - fieldcraft and section training, and field engineering. The complete course covered 42 periods of 45 minutes each. Popular subjects among handicrafts were light carpentry, metal work and leather work.

An Officers' Holding Unit, capable of handling 300 officers was formed at Chessington where the same facilities were available. The Officers formed syndicates and worked under an elected leader. In addition a comprehensive course on Air Force administration was undertaken.

When the end of the first stage in the disbandment was reached the units remaining under the control of Headquarters, Balloon Command, were :-

No.24 Balloon Centre and its anti-'Diver' squadrons

R.A.F. Station, Southend

R.A.F. Station, Great Sampford

R.A.F. Station, Cardington and its balloon training units

Nos.60, 61, 62, 63, 64, 65 and 66 M.T.R.Us.

Nos.1, 2 and 3 Balloon Repair Units.

R.A.F. Station, Zeals.

Nos.1, 6, 11, 12 and 15 Balloon Centres (not yet handed over to Maintenance Command)

No.3 Balloon Centre

No.901/5 Squadron
No.906/10 Squadron } S.W.A. Units

Polish Balloon Unit

/The Second

The Second Stage

ibid. Enc.67A 13.1.45. At their meeting held on the 11th January, 1945, the Chiefs of Staff again reviewed the balloon barrage requirement including the question of the retention of the anti-'Diver' Barrage of 800 L-Z balloons. They agreed that -

(a) The reserve anti-'Diver' Barrage be disbanded.

(b) Sufficient personnel, balloons and technical equipment be retained to provide for :-

(i) an additional 60 L-Z balloons for the Scheldt Barrage in exchange for 200 Mark VI balloons now part of the flying quota.

(ii) a reserve of two mobile squadrons of 50 L-Z balloons each as an insurance against any future possible requirements at short notice.

(c) A sufficient complement of balloons and technical equipment, but no personnel, be held in reserve to provide for a further 250 L-Z balloons and 1,500 Mark VI balloons if they should be required. (1)

(d) The balance of the personnel, balloons and equipment might be disposed of subject to the requirements of approved barrages.

(e) The position be reviewed again in April 1945.

Formation of the Balloon Wing

ibid. Enc.70A 19.1.45. On the 19th January, 1945, Headquarters, Balloon Command, issued amended instructions in connection with the final stage of its disbandment. The previous instructions issued in September, 1944, were intended to cover both stages of the disbandment, but a change in the future balloon policy had necessitated several important amendments.

The Chiefs of Staff had ordered the retention - temporarily at least - of balloon units far in excess of the number visualised by Headquarters, Balloon Command, in September , 1944. It would be necessary therefore to retain some kind of controlling formation. Obviously the time had come when balloons could no longer operate as a separate Command. Also those Balloon Groups which had survived to control the anti-'Diver' Barrage had themselves come "under the axe" during the first stage of the disbandment and were now no longer in existence.

In the circumstances it was decided that a Balloon Wing be formed to control and administer the remaining commitments of Balloon Command. This would function under the direct control of Headquarters, Fighter Command, and would be located at Stanmore as a lodger unit at what was No.3 Balloon Centre. It would be established and assume its responsibilities at such time as Headquarters, Balloon Command, ceased to exist. It would in fact, in many respects, become a replica of that Headquarters.

ibid. Enc.71A 18.1.45. The Balloon Wing was intended to be a temporary formation only, and would probably become redundant after the proposed meeting of the Chiefs of Staff in April. In any event it was not intended to survive the end of the war in Europe. The original intention to reduce all balloon

/activity to

(1) Since personnel for these would be dispersed, the balloons would not be operational for approximately three months.

activity to a nucleus balloon unit located at Cardington held good. Of the units forming the mobile anti-'Diver' Barrage of 800 L-Z Balloons all were now disbanded with the exception of No.951 Squadron which remained based at Great Sampford and No.970 Squadron which took over control at Fairlop. These were retained as the two mobile squadrons of 50 L-Z balloons each, provided for by the Chiefs of Staff. The Reserves allowed for Europe were not required by that Command and were reduced to two squadrons each of 50 Mark VI balloons, namely Nos.998 and 999 Squadrons.

ibid.
Encl.84A.
24.1.45.

The Air Ministry meanwhile issued instructions that all four squadrons should be prepared and ready for deployment at an early date. The mechanical transport repair units formed under Balloon Command were permitted to continue to function temporarily under the control of the Balloon Wing.

The Future of R.A.F. Station Cardington

Royal Air Force Station Cardington was handed over to Technical Training Command with effect from the 21st March, 1945. The Winch Storage and Maintenance Section and the Balloon Technical Training Unit were re-established as a separate unit and located on Cardington. The unit establishment included the hydrogen factories at Bedford, Wellingborough and Cambridge. The Polish Balloon Unit was also taken off the Cardington establishment and established as a separate lodger unit under the functional control of the Balloon Wing. No.60 M.T.R.U. was dis-established and its functions taken over by No.64 M.T.R.U. Stanmore, and the new Balloon Training and Winch Storage Unit.

AHB/IID/314/26
KBC/52726/
Ops. Enc.55A.
1.3.45.

Although handed over to Technical Training Command, it was realised that Royal Air Force Station, Cardington, filled an essential role in the preparation of balloon units, and in the provision of balloons, hydrogen and other equipment. In order to secure the future of balloon research and development, the Air Ministry in its letter, No.S.107285/04 dated the 18th January, 1945, directed that:-

> "The transfer of this station to Technical Training Command is in no way to prejudice the continuance of the facilities at present afforded to Balloon Organisations, or the outstanding function of R.A.F. Station Cardington as the only permanent balloon station in the Royal Air Force".

On the 15th March, 1945, the Balloon Wing took over the outstanding commitments of Balloon Command and the latter ceased to function as an operational formation of the Royal Air Force. Much administration work remained to be carried out before the Command was finally disbanded and rear parties of all Sections were busily engaged for some months after this date.

Balloon Command stands down.

In February, 1945, just before Balloon Command was finally disbanded, an official stand-down parade was held at No.3 Balloon Centre, Stanmore. After the march past of all ranks the Secretary of State for Air (Sir Archibald Sinclair) addressing the parade, thanked them on behalf of the Government for their loyal and courageous service, by which he said they had sustained the highest traditions of the Royal Air Force. He continued :-

/In September,

The Times 6.2.45.

"In September, 1939, Balloon Command was flying some 600 balloons; by the end of the "blitz" it was flying 2,400. The expansion was not easy. Factories making the equipment were damaged by air attack and a large number of balloons were shot down by the enemy.

Having fought through the "blitz" period and the tip and run raids, the balloon crews were now required to combat the flying bombs. It was calculated that a barrage of 500 balloons could be deployed in eighteen days, but the task was accomplished in five, and within a short time nearly 2,000 balloons were flying in defence of the capital. They brought down 278 flying bombs which had eluded other defences.

The work of balloons was by no means confined to the defence of this country, they went into action over the beaches of Sicily and Italy, and flew over the Normandy beaches on D - Day. In the dark days of the war they flew in defence of the Suez Canal, the Persian Gulf and Ceylon. In co-operation with the Royal Navy they helped to guard convoys and naval establishments".

In referring to the work of the Auxiliary Air Force, the Secretary of State said that in 1943, over a thousand balloon sites were staffed by women who shared equally with the men the dangers of bombs, flying bombs, and the hardships of the weather.

The King's Message

A few days later His Majesty The King sent the following message :-

The Times 15.2.45.

"For five-and-a-half years the Balloon Command of the Royal Air Force has played a vital part in the protection of these islands. Now, as the enemy's forces are driven farther and farther away and with our growing mastery of the skies, the time for its disbandment has come.

By night and by day throughout the years of war, you have manned your stations in all weathers and have not flinched under the many and varied attacks of the enemy. When flying bombs were launched against us your response was splendid. You deployed in new positions with exemplary speed. Your success was a tribute to the thoroughness of your training, to the tactical methods you had developed, to the skilful techniques you had devised, and be it not forgotten, to the work of the original Auxiliary Volunteers who had pioneered the way. In our towns and cities many lives and many homes owe to you their preservation.

In our campaigns against the enemy over the seas you have also played your part. All over the world parties drawn from your Command have protected our convoys, and secured the landing of our forces from low-flying attacks.

A special word of praise is due to the airwomen of the Women's Auxiliary Air Force who have manned so many of the balloon sites. They have shown great devotion to duty and have made an outstanding contribution.

As our assault on the enemy reaches its climax most of you are being called to new employment in our Air Force. In whatever fields you serve I wish success to all".

/Conclusion

Conclusion

From the outbreak of war in September, 1939, Balloon Command filled a role in the defence of these islands which will always be difficult to assess. By the nature of the defence that they provided, balloon units were of necessity exposed to the fiercest onslaughts of the enemy's air forces. Casualties sustained by Balloon Command were not large by comparison with Operational Commands of the Royal Air Force. Even so, they were not inconsiderable.

As has been shown the activities of Balloon Command covered a wide range, including co-operative action with both Royal Navy and Army. Balloon units took part in the "Battle of the Convoys"; without the Mobile Balloon Flotilla the Channel Convoy would have been impossible, they were in France during the early stages of the war and were among the last units to leave the French ports in 1940. The war in the Middle East saw balloons playing a vital part. As the ports on the North African coast were captured, the balloons moved in to protect them for the safe use of our ships, bringing the supplies so urgently needed to keep going the advance of our troops. When India was threatened, balloons were woven into the general pattern of its defence. Invasion plans for both Sicily and Normandy included the part to be played by specially trained balloon units, many of which went ashore with the foremost assault troops.

It was originally intended to man balloon units by specially enlisted airmen, who were considered too old to take a more active part in the national defence, but, as the number of barrages increased, it was found necessary to include many younger men. From these were selected the personnel for squadrons sent overseas, for units engaged on convoy duties, and for the specially trained mobile flights, for all of which there were never a lack of volunteers. The balloon operator's duties consisted largely of interminable guard duties, which at any time must be regarded as irksome. Not for him the "glamour of the air crew" or the glory reflected on the ground staff of Operational Commands. His job remained one of the most monotonous of the War, nevertheless, his morale remained high, and his sense of discipline most marked.

What then of the function of Balloon Command as a whole. Were balloons successful in the role of deterrent to raiding aircraft? Were they successful in keeping the enemy at an altitude where our fighter aircraft and anti-aircraft guns could more easily deal with them? Did they serve to maintain public morale? The total of enemy aircraft wrecked as a result of collision with balloon cables is infinitesimal compared with the number of raiders, but of the few that were known to have penetrated the barrage and struck cables nearly 50 per cent became casualties.

What of the large numbers destroyed by our fighter aircraft and anti-aircraft batteries? Would they have achieved so large a measure of success if balloons had not denied the use of lower levels to the enemy? Without detracting in any way from the splendid efforts of both these Commands, assuredly their tasks would have been much more difficult.

How did the ordinary "man in the street" view the protection afforded him by the balloon barrages? We know that many towns asked for balloon protection after receiving a visit from the Luftwaffe. Questions were asked in

/Parliament as

Parliament as to why certain barrages were grounded at the time of surprise attacks. Workers in many important war factories were known to have been far happier when balloons appeared in the vicinity. Prominent people recorded their appreciation of the work of balloon units.

Our towns and cities suffered much from the unwelcome attention of the German Air Force whose attacks were heavy and sustained. Did they suffer proportionately as much as the Allied towns on the continent, which, without adequate balloon protection were the early victims of the Luftwaffe? If the answer to this question is"no", Balloon Command amply justified its existence.