211 If the top cloud limit in the approach and/or target areas was higher than 16 500 feet, the force dispatched comprised only Lancaster and Halifax units, and if necessary, the Halifax units were also withheld.

Apart from the hampering effects of bad weather fronts extending so high up on German defense action, the British were thus able to exploit another advantage:

The German night fighters required more time to reach a combat altitude of 25 000 to 26 000 feet, and while climbing were slower than the approaching bomber force. This frequently made it impossible to redirect them in time for effective action if such redirection became necessary in an unclear tactical situation.

Operations at altitudes close to 26 500 feet also seriously reduced the chances for successful antiaircraft fire, since such distances required too great a fuze range and consequently too big a lead factor. This altitude was the maximum effective range of the German Model 37/38 99-mm antiaircraft gun, which made up the large bulk of all antiaircraft guns in German defense units.

Leaving the target area on their home flight, the Royal Air Force units usually sacrificed some of their altitude advantage in order to escape from the German

211 defense zones at increased speeds and to complicate matter for German pursuit night fighters.

c. Reaction of the Bombers to Antiaircraft Fire. To reduce the effectiveness of antiaircraft fire, the British bombers carried out the following evasive maneuvers:

aa. Altitudes changed frequently within the limits prescribed for each individual aircraft;

bb. Frequent changes in the horizontal course, particularly over the target area, by means of continuous slight curves to left and right;

cc. Sudden dives when spotted by searchlights.

Whenever within a field of heavy antiaircraft fire, each individual aircraft carried out continuous evasive maneuvers. It was standard practice to keep out of the range of medium and light antiaircraft guns;

d. Reaction of the Bombers to Night Fighter Attack. As was the case when crossing areas with strong antiaircraft artillery defenses, Royal Air Force bombers flying over known German nigh fighter zones carried out continuous evasive maneuvers to escape detection by radar instruments and to complicate direction of the night fighters by means of air carried or ground search instruments.

218 In addition the crews of all bombers were required to maintain a constant watch against night fighters in accordance with a plan arranged in al details beforehand. According to this plan each crew member was responsible for one direction, namely:

the pilot for the air in front of his plane,
the bombardier for the air above and below,
the air mechanic for the air forward on the right,
the radio operator for the two flanks,
the upper gunner for the air above the rear,
the rear gunner for the air below the rear.

If it was suspected from visual observation or from ~~xxxxxxxxxxxxx~~ warnings on the Monica or Fish Pond instruments that a night fighter was approaching, the pilot immediately went into what was called a corkscrew spiral, which involved the following

higher speed at a slight down slope with a 30 degree left turn showing 2.5 to 3 notches on the bank-and-turn indicator;

after a descent of 750-1 000 feet a turn of 60 degrees to the right, again showing 2.5 to 3 notches on the turn-and-bank indicator;

after a descent of 750-1 000 feet a climb of 660 feet at a slower speed, and then transition to normal flight with increased vigilance.

213 On some occasions a bomber under attack by a night fighter fires light signals. The purpose was not only to warn other bombers but also to divert the attention of and confuse the night fighter.

None of the above measures taken by Royal Air Force bombers were very effective against attack by German night fighters. The night fighter searching the air for an enemy bomber had one advantage over his enemy, namely that he knew from his instruments precisely in what direction he would sight his

214 his target.

When German night fighters in 1943 received their obliquely mounted guns, the approached their target from below. Blending with the dark underground beneath the bomber, the night fighter thus escaped visual detection even at very close range. This enabled the night fighter pilot to maneuver into attack position and bring down his target with almost absolute certainty with a short burst of very close range fire.

Flying below a bomber the night fighter was also covered against ~~XXXX~~ detection by the British night fighter detector equipment.[98]

98. Sources 7, 19, 29, 43.

7. Use of the De Havilland Mosquito Bomber in the Conduct of Strategic Air Warfare by the Royal Air Force. After various experiments continuing up to early 1943 to determine the best use to be made of the De Havilland Mosquito bomber, findings produced at least one final result:

The Royal Air Force refrained from committing whole units of these aircraft during daylight, although its excellent speed and altitude performance with a bombload of one ton, plus its great penetration range, presented numerous promising possibilities.

The reason here was probably due to the fact that the superior performances of the Mosquito in the final essence wer were due the dispensation with defense weapons and the consequent saving in weight. Operating in formation, these planes would not have been able to exploit to the utmost their advantage of top speeds, which was equal in favorable circumstances to the top speed of the German Me-109 and FW-190 fighters. This would have created the need for defensive weapons, which in turn would have reduced speed performances because of added weight or would have reduced the bombload. The vicious circuit thus set up would have reduced the plane to the status of a medium quality medium size bomber extremely vulnerable to weapons fire because of its wooden structure

2Hb and unsuitable for commitment except with fighter escorts.

These considerations showed that the Mosquito could be used more economically in night missions

a. As a harrass bomber carrying up to 2 tons of mine type bombs and medium caliber demolition bombs;

b. As a long-range escort fighter, carrying four 20-mm guns mounted rigidly in the turret, to protect bomber formations against fighter attack;

c. As a long-range intruder night fighter for action against the German night fighter forces in the form of attacks with bombs and weapons fire against their ground organization and of fighting patrols over their tactical airfields.

When engaged on harras bombing missions the important advantage of the Mosquito against German antiaircraft fire was its exceptionally high operating altitude of 33 000 feet. Its superior speed gave it almost complete safety against German night fighter attack.

The direct strategic importance of the Mosquito as a bomber commenced with the test operations carried out for the Oboe (Boomerang) point navigation instruments early in 1943.

The Mosquito was particularly suitable for this purpose

216 since its operating altitude of 33 000 feet secured a long operating range for the Oboe instruments, which functioned on the "line-of-vision" principle. The range at which these instrumente could thus fuuction was adequate to enable the ground stations in England to control operations at least as far as the Ruhr region.

Another decisively important advantage was that the Mosquito when flying alone had nothing to fear from German night fighters because of its speed of 330 miles, and thus could fly for a long time along a prearranged course, as required for Oboe-controlled operations, without having to carry out evasive maneuvers.

At an altitude of 30 000-33 000 feet the Mosquito bomber was also beyond the range of effective fire by the bulk of the German Model 37/38 88-mm antiaircraft guns, which had an effective range of 26 000 feet, and could be reached only by fire from the Model 41 88-mm, or the 105-mm and 128-mm antiaircraft guns, of which only a few were available to the German defense system.

Another possibility for Mosquito operations developed with the use of the H2S (Rotterdam) target detecting instrument for attacks against large German industrial cities, particularly Berlin, which could be identified with reliability on the Rotterdam screen.

217 Because of its high operating altitude, the Mosquito was practically independent of weather conditions along its route or in the target area, since it could fly above the highest conceivable cloud cover of up to about 26 500 feet.

Operating alone, a Mosquito bomber could also bomb any large target by means of the H2S instrument.

With its excellent takeoff and landing properties, the Mosquito could be committed from airfields in England even under unfavorable weather conditions which made it impossible for 4-engine units to operate.

From the summer of 1943 two clear-cut types of operational mission of a strategic nature thus developed for the Mosquito bomber forces:

218 a. Attacks against particularly important point targets, such as the hydrogenation plants in the Ruhr region, close enough for control by Oboe, GH, or Micro-H instruments;

b. Harrassing attacks against large German industrial and other cities and towns, by means of the H2S instrument, in all kinds of weather.

Operations against the targets under Category (a), above, took the form of attacks by between five and twenty Mosquito bombers following each other in rapid or long sequences against one or more targets in industrial centers or their

218 vicinity.

Operations of type (b), above, commenced with harass bombing of targets within Germany or the Holland-Belgium area by forces of 5-10 Mosquito aircraft, increasing steadily in size as the output in these aircraft increased to attacks by as many as 100 Mosquito bombers in a single night.

Already by October 1943 harrass bombing attacks by Mosquito bomber aircraft against targets in the Ruhr region and Holland and Belgium assumed such proportions that the German night fighter command responsible in these areas, the I Fighter Corps, saw reason to address the following teletype message to Air Command Center, the headquarters responsible for air defense of the Zone of Interior:

> Since the night fighter aircraft available to the I Fighter Corps are unsuitable, by reason of their technical performances, for action against British harrass planes operating at speeds above 300 miles and at altitudes above 23 000 feet, and since the Royal Air Force is steadily increasing its harrassing activities, the request is submitted for an accelerated delivery of night fighter units which can be committed with prospects of success in action against Mosquito aircraft.

219 On the night of 12 December 1943 a night fighter using waiting position tactics for the first time succeeded in shooting down an Oboe-directed Mosquito bomber. The night fighter pilot was highly experienced, and had already shot down more than fifty enemy planes. He was flying a plane especially adapted for counter-Mosquito action, a Ju-88 plane of the R-2 Series, powered by two BMW-801 engines with the booster GM-1 attachment for temporary acceleration, and equipped with SN-2 search instrument.

Only very few Mosquito aircraft were shot down, and these only under exceptionally favorable circumstances for the defense, later because of the commitment of faster Me-410 and He-219 night fighter aircraft on the German side.

In February 1944 the overall commitment of Mosquito bombers alone in operations over Germany mounted to a total of approximately 900.

Although the direct impact of these attacks on Germany's wartime production did not yet constitute a grave threat, the fact that they resulted in large areas being placed under air alert cause widespread and serious disquiet among the civilian population , and the long duration of these wide-area air Alerts was beginning to cause a noticeable loss of industrial output.

The majority of the attacks were directed against targets

219 in the Rhine-Westphalia industrial region, although frequent attacks also extended to Berlin.

March 1944 saw a further increase in harass operations by Mosquito bombers, with a total of 1 400 of these aircraft dispatched against targets within Germany alone. Reduced

220 industrial output due to the frequent air alerts began to assume grave proportions.

The advantages which the Mosquito bombers had over German night fighters were so pronounced that they could even continue their attack operations during periods of full moon.

On the German side neither the antiaircraft artillery nor the night fighter forces had any means of defense available which could be used with any prospects of telling results against Mosquito bombers. The attacks now became a veritable Mosquito plague.

German reaction to this grave situation took the form of the establishment of a special detachment, Experimental Detachment 410, at Venlo airfield on 1 April 1944. Using various aircraft types and methods, this detachment was to investigate the best possibilities for successful action against Mosquito units at night.

The aircraft types used for the purpose were as follows:

Night Fighter Ju-88-R-2with GM-1 Booster attachment and SN-2 instrument;

220 Night Fighter Me-410 with GM-1 Booster attachment and SN-2 search instrument;

Night Fighter He-219 with GM-1 Booster attachment and SN-2 search instrument.

The requirement stated by the Night Fighter Command was that Me-262 and Ar-234 jet aircraft were to be used for this purpose later.

The primary mission assigned to Experimental Detachment 410 was to repel the attacks by Oboe-guided Mosquito units against
221 targets in the Ruhr region. For this reason the anti-Mosquito night fighters were employed under the waiting position method and controlled from the night fighter control positions north, west, and south of the Ruhr region. On clear nights anti-Mosquito operations were also supported by searchlights in the antiaircraft artillery defense zone.

Although the radar instruments of the night fighter control positions were not systematically jammed during harassing attacks by Mosquito units, anti-Mosquito operations using the waiting position (Himmelbett) tactics presented serious technical difficulties with small prospects of success. The aircraft used by the Experimental Detachment for the purpose could, with their GM-1 Booster attachment, at best achieve the maximum speed of the Mosquito aircraft.

When operating over enemy (German) territory, the Mosquito

221 Mosquito units flew at approximately 10 percent, or 36 miles less than their maximum speed of 360 miles.

This meant that a night fighter dispatched against a Mosquito unit ten miles distant had to pursue the target for ten minutes at its top speed, and thus with a speed advantage over the target of approximately 36 miles, before sighting it.

In this time the enemy plane, travelling at a speed of approximately 360 miles, covered a distance of 54 miles. This approximated the distance which two or three Wuerzburg radar instruments could cover. This in turn meant that target and pursuit plane had to be turned over two or three times from one night fighter control position to the next for control purposes. It was on only rare occasions that this transfer of target and pursuit plane functioned perfectly, since the Mosquito plane because of its wooden

222 structure was difficult to detect and track. Once the target was lost, the night fighter mission was fruitless.

Control of the night fighter by the Benito system extended over a larger area than that by the Wuerzburg radar instrument, but was useless if the Wuerzburg instrument could not keep track of the target for a corresponding distance.

222 To commit fighters in roving missions against the Mosquito units held out no prospects of success since the Mosquitos penetrated individually on harass bombing missions against numerous targets distributed over wide areas.

Chances for successful antiaircraft fire from the ground existed only in areas with modern antiaircraft guns and target locating equipment and only if favorable conditions were available for operations with the powerful 20-centimeter searchlights.

The Mosquito travelled much too fast for successful antiaircraft fire relying on electronic target data.

The undisputed superiority of the Mosquito throughout the territories defended by the German Air Force became clearly evident in the small losses these units incurred in their attack operations.

Thus, German night fighters shot down only one Mosquito plane in January and one in February 1944, and none at all in March and April . In May 1944 only four were

223 shot down out of 950 committed in night attacks, against eleven German night fighters lost, most of them due to weather damage.

The fact that the German side was powerless against attack operations by Mosquito units is also illustrated

225 clearly by the fact that even when Experimental Detachment 410 was established only completely inadequate forces were available for commitment in this defense effort. Thus only one Me-410 plane was available in the whole command area of the I Fighter Corps on the night of 13-14 April 1944 for anti-Mosquito action.

For the above reasons it is only logical that the German side began to fear that the Royal Air Force might at some future date decide to use Mosquito bombers on a large scale in its night attack operations. That these fears did not materialize by the end of the war was a surprise to the German defense authorities.

The Royal Air Force carried out only one concentrated bombing attack with Mosquito aircraft. This was an attack by approximately 200 of these bombers against Nuremburg on the night of 28-29 November 1944. On the other hand, the scope of Mosquito harass attacks increased throughout 1944, with 150-200 of these units committed in such missions on a night, commitments of this size exceeding in frequency similarly large commitments of 4-engine bombers.

The tests carried out by Experimental Detachment 410 had shown that the only German plane available with a large enough margin of superiority for successful counter-Mosquito action was the single-seater Me-109 fighter powered

224 by the DB-605-AS engine with GM-1 Booster attachment.

On 1 July 1944 the I Fighter Corps as a local command measure activated a reinforced squadron, the 10th Squadron, 300th Fighter Wing, with Me-109-AS airrraft specifically for the defense of Berlin, one of the most frequent targets of attack by Mosquito bombers. This squadron operated exclusively with support from searchlight units of the anti-aircraft artillery in the Berlin area, and therefore could only operate in weather in which searchlights could spot Mosquito aircraft flying at an altitude of between 30 000 and 33 000 feet.

It was November 1944 before further units for night operations against Mosquito aircraft were activated in the command zone of the I Fighter Corps and placed under the 1st Group, 11th Night Fighter Wing to protect the Ruhr region and the Frankfurt basin areas. At the same time the 10th Squadron, 300th Fighter Wing, stationed in the Berlin area, was to be expanded to form the 2d Group, 11th Night Fighter Wing.

Shortages in aircraft and fuel prevented completion of the above projects. Consequently the German Night Fighter Command at no time had more than 20 to 40 night fighters available for action against an average number of between 100 and 200 Mosquito bombers operating over

224 German territory each night.

Operations with these small defense forces were not entirely unsuccessful, and 37 Mosquito bombers were shot down in 1944. However, these succ sses were negligible compared with the total number of penetrations by Mosquito units. Furthermore they were costly for the German Night fighter Command, which lost 98 night fighter aircraft in the operations involved, so that the whole matter proved uneconomical.

The heavy losses on the German side were due primarily to the fact that the Mosquito bomber could operate in all weather and usually compelled the German defense to take action in very bad weather conditions in which the Me-109 was technically not suitable to operate. The blind navigation, time-in-air capabilities, and de-icing equipment of the Me-109 were totally inadequate and made night fighter operations at altitudes between 30 000 and 33 000 feet impossible even for the most experienced pilots. For these reasons most of the losses incurred on the German side were due to weather difficulties.

Tests carried out in early 1945 with Me-262 jet night fighter aircraft produced good results in action against Mosquito aircraft at night when the weather and other conditions were favorable for searchlight spotting.

225 In one night, for example, four Me-262 night fighters shot down four Mosquito bombers. However, the Me-262 had a time-in-air capability of only fifty minutes, so that no solution could be found for the weather problem. Furthermore, more time would have been necessary to convert the Me-262 from a single-seater daytime fighter to a two-seater night fighter with proper search equipment and reserve fuel tanks to increase its time-in-air capabilities.

From all of the above it is evident that the Royal Air

226 Force had in its Mosquito bomber a weapon for strategic attack with the following advantages over the German defenses:

a. Complete all-weather operability due to its operating range and altitude capabilities;

b. Superiority over the German antiaircraft artillery and night fighter defenses because of its great operating altitude and speed;

c. Good capabilities for effective action, because of its heavy bombcarrying capacity and its equipment with Oboe and H2S navigational instruments, against point targets and area targets, the former as far as the Ruhr region and the Frankfurt basin area up to November 1944 and from then on also against targets in Central Germany by means of Micro-H control; the latter including all types of large-area targets and other targets

226 which could be properly identified on the screen of the H2S instruments;

d. The ability to cause widespread unrest, loss of working time, and local damages through an unlimited commitment of numerous individual planes against a large number of targets distributed over large areas;

e. The ability to support and screen operations by the strategic 4-engine bomber forces in action to mislead the German defenses;

f. Minimum requirements in personnel and materials for both crews and aircraft.[99]

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99. Sources 29; Study 158-160, Volumes I-IV; Study 164, Volumes II and IV.

CHAPTER 5

THE US ARMY AIR FORCES

October 1943 to End of the War

1. Bomber Unit Formations. The Combat Wing formation of 3 groups of each three 6-aircraft squadrons in box formation adopted in March 1943 proved inadequate in the costly operation against Schweinfurt on 14 October 1943 for defense against German night fighters. The US Eighth Air Force thereupon experimented with newly developed formation patterns to improve the maneuverability and defense capabilities of its bomber forces.

From October 1943 to January 1945 the bomber group was organized in three squadrons of each 12 aircraft, making a total group strength of 36 aircraft. Each aquadron was organized in four flights of three aircraft.

Two particular reasons were the determining factor in the adoption of this new formation pattern:

a. The introduction and preference for blind bombing techniques, which greatly reduced the problem of defense against fighter attack;

b. The increasing penetration range of escort fighter aircraft, which greatly reduced the problem of self defense by the bombers , particularly since

227 the US Army Air Forces refrained from attacking targets beyond the range of escort fighters during weather conditions which permitted unrestricted German fighter activities

Lacking Pathfinder units equipped with H2S equipment, the techniques of blind bombing initially required the closest possible concentration of units in order to achieve the effects of saturation bombing by means of unit simultaneous bomb release methods (Bombenteppich).

The group had a lead squadron, a high altitude squadron and a low altitude squadron, flying in wedge formation.

In the new fromation pattern of group formation, the three aircraft of each flight flew at the same altitude, one flight higher, and one flight lower than the lead flight of the squadron and slightly in its rear.

As part of larger forces, the groups flew in column spaced appriximately 6 600 to 7 00 yards apart.

GROUP OF THREE 12-AIRCRAFT SQUADRONS

October 1943-January 1945

Lead Squadron

3d Squadron below, 2d Squadron above lead squadron.

228 From January 1945 on German defense fighters no longer represented an important hazard. Further the numbers of escort fighters available with an adequate penetration

229 range insured safe protection of the bomber forces against German fighter attack.

It was of far greater importance at this juncture to find a formation pattern which would reduce the effectiveness of the steadily mounting intensity of German antiaircraft fire. The important point here was to reduce the dimensions of the closely organized formation so that it could pass through the field of antiaircraft fire more rapidly.

The brought a return to the 3-flight squadron in place of the 4-flight squadron so that each group now had three 3-aircraft flights .

Other advantages of the 9-aircraft squadron, flying in close formation to take up as little space as possible, were that it improved cohesion within the larger unit, provided greater flexibility, and was easier to control and maneuver.

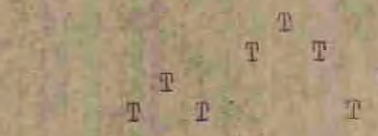
The firmer control thus achieved in group formation at the same time insured greater precision in simultaneous bomb release operations, while the shorter column meant

229 that the whole force could pass rapidly through zones of heavy antiaircraft fire.

The new pattern of unit formation proved so satisfactory that the B-17 forces retained it up to the end of the war.

GROUP OF THREE 9-AIRCRAFT SQUADRONS
January 1945 to End of War

Lead Squadron



3d Squadron below, 2d Squadron above lead squadron

B-34 bomber aircraft were a little more difficult to handle in formation. For this reason a modified version of the 27-aircraft group formation pattern developed from February 1945 on in the B-24 units of the 2d Bomber Division under the US Eighth Army Air Force. The difference at squadron level was that only one flight of each squadron was echeloned sidewards from the lead flight, with the other flight in the direct rear but lower than the lead flight.

B-24 Squadron in Half-Wedge Formation
February 1945 to End of War

Lead Flight

230 Another variant was adopted by the 96th Bomber Wing of the 2d Bomber Division. Here, each flight of the squadron flew in column, echeloned in depth. The group was organized in wedge formation.

B-24 SQUADRON IN FLIGHT COLUMN FORMATION (96th Wing)

Lead Flight

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This formation not only decreased the dimensions of the group and improved the bombing pattern by each unit, but enabled all three groups to give each other more effective fire support.[100]

An examination of the final formation patterns adopted by the American strategic bomber forces reveals that they were very similar to the German systems at the beginning of the war. The only difference is that in the German system high and low echeloning alternating the pattern of from squadron to squadron and within the group, and from group to group within the wing was not used. As a rule, German forces at the beginning of the war were echeloned in height above the lead unit.

The following principles can be deduced from the development of formation patterns in the American strategic

231 bomber forces:

a. If the enemy has air superiority over the areas of operations, that formation will be best which will insure the greatest possible concentration of defensive fire by the bombers against attacking fighters while preserving the factor of maneuverability;

b. In the case of own air superiority over the enemy territories, bombing conditions and the effectiveness of the enemy antiaircraft artillery defenses will determine the best formation pattern.

A closely spaced placing of bombs in unit bomb releases and a quick transition through antiaircraft fire zones are favored by close formation flight in small units.

2. American Blind Bombing techniques. As early as in the autumn of 1942 the US Army Air Forces considered ways and means to sustain a continuous air offensive against the German armament potential in a manner which would leave the German side no time for recuperation. These considerations were due to the frequent periods of unfavorable weather over Western Europe.

The initial outcome of these deliberations was the plan to use the British Gee, Oboe, and H2S navigational instruments for daytime harass attacks during unfavorable

232 weather. These attacks were to be carried out by individual B-24 bombers on a scale which would keep large areas of Germany under a state of perpetual alert, and which would serve to wear down the German defense potential under conditions which left the defenders practically no chances of successful action.

Under this plan eight B-24 Liberator bombers were equipped with Gee instruments and towards the end of 1942 commenced a campaign of harass attacks against targets in the western areas of Germany. However, the results achieved proved unsatisfactory and the attacks ceased in March 1943.

The US Eighth Army Air Force also did not find the Oboe system satisfactory. With its range of only roughly 200 miles, the distance at which units could operate under control by stations in England was too small for strategic

233 purposes. Another factor here was that the Royal Air Force refused to permit use of the instruments for daylight operations over enemy territory out of concern that some of the highly important instruments might be captured by the enemy.

Following the example of the Royal Air Force, the US air forces thereupon carried out [illegible]st operations for

233 the use of Pathfinder units with H2S equipment to guide bomber forces for precision bombing attacks without visual sighting when a closed cloud cover over the target area made visually aimed bombing impossible.

For this purpose the US Eighth Army Air Force requested from the Royal Air Force urgent delivery of eight H2S instruments. The Royal Air Force undertook to deliver the instruments soon, but the industrial output in these instruments was too small to satisfy the needs of the British and the American strategic air forces in Europe. An agreement was therefore reached that the American Radiation Laboratory was to copy the British H2S instrument, and was to meet the needs of the US Eighth and Fifteenth Army Air Forces in this item from September 1943 on. The instruments produced in America under this agreement were designated H2X (Meddo).

By 20 September 1943 twelve B-17 Fortress bombers had B2X equipment. These eight bombers arrived in England at the end of September. There the navigation officers received additional training from the Royal Air Force, and more 4-engine aircraft of the US Eighth Army Air Force received H2X equipment. This made it possible to initiate activation of the 482d US Pathfinder Group, containing

233 three squadrons, in September 1943. The first of these three squadrons had British H2S instruments, the other two

234 had the American H2X instruments.

Apart from a test mission by one B-24 bomber with H2S equipment, which attacked Frankfurt on 17 August 1943 within the scope of the US Eighth Army Air Force operation against Regensburg and Schweinfurth on that day, the squadron with H2S equipment was committed for the first time on 27 September 1943 in an attack against Emden, the two squadrons with H2X equipment for the first time on 3 November 1943 in an attack against Wilhelmshaven.

Under the American system of Pathfinder controlled operations, one plane with H2S or H2X equipment flew in the position of the combat wing commander and released a smoke signal from the bomb release shaft as the signal for the simultaneous bomb release by the entire formation.

Emden was selected as the first target for a major attack with blind bombing methods for the following reasons:

a. Emden was an important sea port on the North Sea coast of Germany;

b. The target was small enough to test out the accuracy of bombing with the H2S instrument;

c. The position of the target at the coast facilitated its identification on the H2S screen, which

234 clearly showed the borderline between land and sea;

d. The target was close enough for uninterrupted fighter escort protection to the target and back by four groups of P-47 fighters equipped with reserve fuel tanks.

235 Two bomber divisions with a total strength of 305 4-engine bombers and approximately 100 fighters participated in the attack against Emden on 27 September 1943. Each bomber division had two Pathfinder aircraft with H2S equipment, which led the division. The mission of the Pathfinder units was to mark by smoke signals the bomb release point for each wing.

The method functioned for the first and second wing of each division, but in each case the third wing was unable to see the markings and bombed chance targets.

Emden was bombed by 244 4-engine bombers, out of which the German defenders shot down seven, in addition to two escort fighters.

On 2 October 1943 339 4-engine bombers from the US Eighth Army Air Force, under constant fighter escort, again bombed Emden, this time losing only two bombers to German defense action.

An analysis of the results obtained in these two operations gave cause for a carefully optimistic appraisal of the new blind bombing techniques.

235 An important reason for the inaccurate bomb placing by the two last wings was that the air markings set by the Pathfinders to mark the bomb release point drifted off too fast in the strong high altitude wind. The only requirement obviously was to furnish enough aircraft with H2X equipment to give each bombing unit its own Pathfinder, so that the smoke signal would not serve as a target marking but as the signal for the bomb release instead.

In each case the two blind-bombing attacks by large forces against Emden proved that a closed cloud cover along the approach route and over the target seriously hampered the defending German fighters and thereby provided the most effective protection against fighter attack.

It was only logical that the American strategic bomber units also made use of means to complicate the aiming of German antiaircraft fire through a closed cloud cover against targets which could not be observed with optical means.

For this purpose it was necessary to interfere seriously with the functioning of the Wuerzburg and Mannheim target locating instruments of the German antiaircraft artillery.

After the resounding success of the British with the use of tinfoil on the night of 24-25 July 1943, the

236 US Eighth Army Air Force did not hesitate to use this new means in the execution of blind bombing missions.

Under the designation "Chaff" the US Eighth Army Air Force introduced the measures known as the British "Window" system, but instead of using the British 14 by 20 inch tin-foil strips, used metal foil strips 11 inches long and 1/16 inch wide.

The Carpet aircarried radio jamming transmitter used by units of the US Eighth Army Air Force for the first time on 8 October 1943 to jam the German Wuerzburg equipment also proved a highly effective component of blind bombing techniques.

The use of the H2X, Chaff, and Carpet system in operations against targets under a closed cloud cover gave the American strategic bomber forces justified reason to consider that the weather problem in strategic air warfare was mastered.

With the progressive equipment of all lead planes with H2X instruments, supplemented in 1944 by instruments similar to the Oboe for precision bombing attacks against close range targets, the American air forces had completely mastered the problem of weather over enemy territory. They could now attack any target regardless of whether it could be seen from the air or was concealed by a thick cloud cover.

237 One problem yet unsolved was that of whether weather conditions in the approach areas and the target area were still favorable enough for the defenders to commit their fighters in concentrated force against the bombers, and whether and to what e tent the German antiaircraft artillery at the target could locate the bombers by means of electronic equipment. The most urgent requirement now was therefore to find a solution for the problem of escort protection during fair weather operations, the only possible solution here being that of achieving a considerable increase in the penetration range of US fighter aircraft.

It was an exceptionally favorable circumstance for the American strategic bomber forces that a very favorable solution to this problem was found in the P-51 Mustang fighter at the end of 1943, precisely at the time when the techniques 238
238 of blind bombing were introduced.

The use of blind bombing techniques by the American strategic bomber forces created an entirely new problem for the German fighter defense command, for the solution of which no prerequisites existed:

a. Either in point of training or of their aircraft German fighter pilots were unable to fly through a closed cloud cover in a manner which would enable them to

101. Sources: The AAF, Volume II, pp. 233, 322, 690-695, 720.

238 to reassemble in unit combat formation above the clouds.

b. German twin-engine fighter pilots were trained for blind flight and instrument navigation, and were able to reassemble in unit combat formation above a dense and thick cloud cover, but their aircraft were not suitable for action against bomber forces operating under fighter escort.

On the occasion of the first H2S-guided attack by units of the US Eighth Army Air Force against Emden on 27 September 1943, the German 3d Fighter Division at Deelen succeeded in dispatching five fighter groups stationed on airfields in Holland and guiding them one at a time through cloud gaps to combat altitudes. There was a cloud cover of 3/10 to 9/10 on this day extending between 1300 and 10 000 feet up, and as soon as the five German fighter groups emerged from this bank of clouds, with a visibility range of roughly six miles, they stood out clearly against the clouds beneath them . Flying at a much higher altitude the American P-47 fighter units therefore spotted them immediately, even from great distances while they were still climbing to proper combat altitudes and engaged them in combat. Consequently, they were unable to attack the bombers.

The German 2d Fighter Division at Stade sent up its 26th twin-engine Fighter wing with its two groups and dis-

239 committed the whole wing against the US bomber force after the individual units had reassembled above the clouds. This force also came under attack by the American escort fighters while still approaching the American bomber force an therefore was unable to bring its full power to bear against the bombers.

The outcome of these operations clearly illustrates the difficulties for defensive action:

The 120 single-engine and 40 twin-engine fighters committed shot down seven 4-engine bombers and two escort fighters, themselves losing ten single-engine and one twin-engine fighters.

Similar difficulties were encountered by the defending fighters in the repeat attack against Emden on 2 October 1943:

The 216 single-engine, 42 twin-engine, and 5 night fighters sent up on this occasion lost ten single-engine aircraft and shot down only two of the attacking US 4-engine bombers.

The outcome of fighter defense operations in the zone of the German I Fighter Corps on the occasion of the first US operation employing the two Pathfinder squadrons which had H2X equipment was nothing short of catastrophic. In

239 this case the US Eighth Army Air Force on 3 November 1943 dispatched 528 4-engine bombers under fighter escort to bomb Wilhelmshaven. All that the War Journal of the German I Fighter Corps has to say on its own fighter defense action was that it was not possible to obtain a clear picture of what had happened and that the German fighter forces suffered numerous weather losses.

On this day thewhole of northern and northwestern Germany was under a dense cloud of high fog, with a ceiling of 165 to 330 feet.

On the occasion of the Pathfinder-guided attack by 112 4-engine bombers of the US Eighth Army Air Force, plus escort fighters, against targets in the Aachen-Bonn area on 7 November 1943, low-hanging clouds and snowfalls made it impossible to put a single German defense fighter in the air.

Throughout November 1943 the fighter units of the I Fighter Corps suffered exceptionally heavy weather losses in operations in defense of the Zone of Interior. Thus, units operating against large-scale penetrations by the US Eighth Army Air Force lost 19 aircraft on 13, 22 on 26, and 32 on 29 November. All of these losses were due primarily to ice formation while the units were passing through the clouds.

The German Fighter Command from then on had to exercise extreme caution in committing its units during uncertain

240 weather because of their inadequate training and equipment for such conditions. For this reason nor fighters at all were dispatched on a number of occasions against penetrating US forces, while on numerous occasions only some elements could be committed when conditions were too unfavorable in other areas for the fighter units to take off. 241

From the above it evolves that American blind bombing techniques proved a highly effective weapon against the German fighter defense system in two respects:

a. By hampering German fighter defense activities on the whole, because German fighter pilots by reason of their training and equipment were only able to reach combat altitudes in unit combat formation and to land safely after action during favorable weather;

b. By creating for the German fighters the hazards of heavy weather losses if they succeeded in taking off for action during passable weather but encountered conditions while climbing through clouds or descending for a landing which exceeded the capabilities of personnel and air raft.

The weather factor remained a constant ally of the American strategic air forces to the detriment of the

102. Sources 29; Study 158-160, Volumes I-IV; The AAF Volume II, pp. 849, 850.

241 German fighter forces.

Although the American bomber units after perfection of their fighter escort system in 1944 still showed a marked preference for precision bombing with visual aiming at the target, the units participating in such missions usually had to cross different weather areas on their long approach and return routes. In all cases the German fighters therefore in some areas enocountered weather problems which restricted their action.

To some degree the German Air ~~Force~~ Force High Command was co-responsible for the weather advantage the US air forces had, because of the inexplicable way in which it neglected opportunities to seek for a solution to the all-weather problem. No measures at all were taken on the German side in the fields of training and equipment to prepare fighter personnel for all-weather unit operations as had been done from the beginning on the American side by means of giving their fighter pilots training in blind flying and instrument navigation, and by giving the single-seater fighter aircraft radio compasses and direction finding apparatus which enabled the pilot to operate by simple position line navigation and to find his way to his airfield.

It was November 1944 before the Commander in Chief of the German Air Force made a determined effort to solve

242 the problem of all-weather daylight fighter operations. In the conference held on 16 November 1944 Reich Marshal Goering ordered the following measures:

a. The training program for future daytime fighter pilots was to be adapted largely to training for all-weather operations;

b. An investigation was to be made into what technical aids for all-weather operations could be provided in single-seater fighter aircraft;

c. Various methods were to be tested for daytime fighter operations in various conditions of bad weather with various cloud covers, upper cloud levels, and cloud density;

d. Personnel were to be taken primarily from the bomber units of the IX Air Corps, which were to reorganized as fighter units, for training in all-weather

243 fighter operations

e. The suitability of the Me-262 for all-weather fighter operations was to be investigated. 103

The materialization of these intentions was hampered at this late stage in the war by a hopeless shortage of fuel and aircraft. This enabled the American strategic air forces to maintain right up to the end of the war the

243 superiority they had gained over the German fighter defenses through the application of their blind bombing techniques.

For the German antiairaft artillery defenses the American blind bombing techniques combined with the use of tinfoi and of the aircarried Carpet jamming radio transmitter created very serious handicaps even during daylight when conditions of visibility made target locating entirely dependent on the Wuerzburg and Mannheim radar instruments.

In May 1944 the antiaircraft artillery forces committed within Germany had available approximetely 2 500 Wuerzeburg D, 1 000 Wuerzburg Riese, and 250 Mannheim instruments for the electronic procurement of target data.

Out of this number approximately 25 percent of the Wuerzburg type instruments had been adapted by that month through installation of the Wuerzlaus attachment to operate with a 50 percent locating accuracy in the presence of medium quantities of tinfoil.

The Mannheim instruments were more suitable for the purposes of antiaircraft fire, but no means had as yet been found to render them proof against tinfoil interference.

244 Research to improve the functioning of the Wurzlaus attachment produced a new attachment, the Taunus, at the end of 1944.

244 This new attachment for interference suppression made the procurement of electronic firing data conditionally possible even in the presence of large quantities of tinfoil, but even this latest improvement did not provide adequately precise target data.

Finally, experiments were carried out with the Steinhaeger instrument for sonic target data procurement when the enemy made large use of tinfoil.

No really practicable solution was found by the end of the war for the problem of protecting the electronic target detecting equipment of the antiaircraft artillery against the Anglo-American methods of interference. In fact, it was not even possible to furnish adequate numbers of the imperfect Wuerzlaus and Taunus interference suppressor attachments.

Whenever the US bomber forces did their bombing through a closed cloud cover with the aid of their H2X instruments, the German antiaircraft artillery therefore had to resort to a form of barrage fire based on firing data procured with improvised means. This, in turn, necessitated heavy concentrations of antiaircraft batteries at the most important targets, to achieve which other targets had to be stripped of antiaircraft defenses.[104]

104. Sources 70, 72; Koch, pp. 132-134 ff.

245 From the above it evolves that the American air forces by means of their blind bombing techniques and through the use of tinfoil and aircarried radio jamming transmitter also achieved superiority over the German antiaircraft artillery defenses and maintained that superiority up to the end of the war.

245

3. The American Escort Fighter System.

A. INCREASED PENETRATION RANGE AND NUMERICAL STRENGTHS

After the group of P-38 Lightning fighters transferred from the North African theater to England had been readied for operations, and after the installation of two 108-gallon reserve fuel tanks in the aircraft of the P-47 groups had made sufficient progress by 15 October 1943, the US Eighth Army Air Force on the occasion of its operation against Wilhelmshaven on 3 November 1943 for the first time found itself in the position to provide strong fighter escorts for the bombers as far as their target. This target Wilhelmshaven, was 36 miles farther inland than Emden, which had been the target of a fighter escorted attack, by P-47 fighters, already in September. In the Wilhelmshaven operation, the P-38 group provided fighter protection for the bombers over their target, and without themselves incurring any losses shot down three of the German fighters attacking in scattered force. In addition, the German fighter forces on this day suffered very heavy weather losses.

On 13 November the P-38 group alone escorted the bomber force attacking Bremen, the P-47 groups having returned to their bases after accompanying the force to the extreme limit of their penetration range. This was the greatest distance over which bombers had hitherto had

246 operated under continuous fighter escort. On this occasion the P-38 group was numerically inferior to the German fighters in the Bremen area, which were able to go into action without interference by weather conditions. The group lost seven of its P-38 aircraft, and another sixteen were damaged by weapons fire. Nevertheless, the fighter escort group served its purpose by keeping bomber losses within tolerable limits: 16 of the 143 attacking 4-engine bombers were shot down.

The US VIII Fighter Command fully realized the inestimable value of the P-38 as an escort fighter because of its long penetration range of roughly 500 miles. Basically, however, the command held the opinion that it was not an ideal aircraft for such purposes because German fighters could identify it more easily than any other type at great distances because of its double fuselage, so that it was frequently exposed to surprise attack.

On the other hand, the suitability of the P-47 Thunderbolt fighter for long-range escort missions was limited by the fact that its achievement of the necessary penetration range dependended too largely on its reserve fuel tanks. These impaired the flying properties of the P-47 so seriously that they had to be jettisoned as soon as German fighters were encountered. If this happened at an early stage during

247 a mission, what was left of the fuel in the reserve tanks was no longer available to increase the plane's range! This created the grave risk that the escorting fighter units might not be able to fly as far as planned, so that the bombers would be exposed without fighter protection to German fighter attack throughout part of the route to and from a target.

The stated specifications of the US Eighth Army Air Force therefore called for provision of a fighter aircraft for escort missions which, without reserve fuel tanks, would have the necessary penetration range, combined with maximum capabilities as a fighter in all other respects.

From such trains of thought, the VIII Fighter Command evolved the idea of adopting the North American P-51 Mustang fighter for strategic missions as a long-range escort fighter. Originally, the P-51 had been intended for tactical missions as a fighter-bomber, and aircraft of this type had been assigned to the US Ninth Army Air Force.

Under an agreement between the two air forces, the US Ninth Army Air Force in November 1943 made the 354th Fighter Group, equipped with P-51 aircraft, available to the Eighth Army Air Force for employment on escort missions in strategic operations.

247

THE P-51-B MUSTANG II FIGHTER
TECHNICAL DATA

Power Unit: One Packard Merlin V-1650, with two multistage superchargers

Take-off thrust: 1500 horse power

Rated power : 1155 horse power at an altitude of 23 000 feet

Fuel Loads and Operating Ranges:

	Old Model		Later Model	
	Fuel Load (Gallons)	Range (Miles)	Fuel Load (Gallons)	Range (miles)
Normal	184	720	269	1080
With two 75-gallon reserve tanks	334	1260	419	1620
With two 150-gallon reserve tanks	484	1710	569	2100

In addition to the two tanks totalling 184 gallons in the wings, the models manufactured after May 1944 had one 85-gallon tank in the body.

The two 150-gallon tanks were used only for the delivery flight to England.

Maximum speed: 387 miles at an altitude of 27 000 feet; with short-time water injection booster (3x5 minutes) 396 miles

Maximum altitude: 40 000 feet

Weapons : Four 12.7 mm machine guns mounted in wings with each 250 rounds.

On its first strategic mission the 354th Group provided

248 P-51 fighter units to escort bomber units of the US Eighth Air Force attacking targets in the Paris area on 5 December 1943. On 13 December already the P-51 units participated with the P-38 group in escorting the 4-engine bombers of the Eighth Air Force as far as their target, Kiel.

In the attack by bomber units of the Eighth Air Force against Bremen on 20 December, 44 P-51 and 35 P-38 escort fighters provided protection over the target and repelled and scattered attacking German twin-engine fighters, which were greatly feared with their rocket weapons.

On 30 December P-51 and P-38 units escorted a bomber force attacking Ludwigs, as far as the target.

On 24 January 1944 the British and American air commands in England reached an agreement under which the majority of the P-51 groups already in existence under the Royal Air Force and in tactical air forces were to be transferred to the US Eighth Army Air Force for use as long-range escort fighters.

In 1944 P-51 fighters with two 75-gallon reserve fuel tanks flew escort missions as far as the Berlin area.

With its 85-gallon fuel tank in the body plus two 75-gallon reserve tanks, the P-51 Model which became available in May 1944 could reach practically any point within the European Theater of Operations from airfields in

249 England to escort 4-engine bombers on their bombing missions against targets as far as the eastern territories of Germany or from airfields in Italy against targets throughout the Balkans and in Czechoslovakia. 105

Concurrently with the increasing range of the P-51 and the mounting number of escort fighter units equipped with this excellent fighter model, in place of their former aircraft, the number of fighter units available to the US VIII Fighter Command for strategic missions also increased steadily in the winter of 1943-44.

The VIII Fighter Corps had available

On 5 Sep 1943: more than 3 fighter wings with 7 fighter group
On 6 Mar 1944: " " 3 " " " 13 " "
on 1 Oct 1944 " " 3 " " " 15 " "

The normal fighter group strength was 48 aircraft, but in 1944 group strengths reach a figure of 90 aircraft. In order to increase felxibility and maneuverability such large groups were subdivided to form each an A and a B Group, each under a separate group commander.

All of these fighter forces were intended specifically for long-range missions escorting 4-engine bombers of the US Eighth Army Air Force. In addition the British and American tactical air forces assumed responsibility within the striking range of their fighter units for for protection of

250 the strategic bomber forces on the outward and home routes.

All in all the number of American and British fighters committed in various operations were as follows:

On 14 October 1943, for the bombing of Schweinfurt:

220 P-47 fighters on the outward and home route as far as the Aachen-Eupen area;

40 Spitfire fighters } to meet the bombers on their return
80 P-47 fighters } route at Amiens.

On 13 November 1943, for the bombing of Bremen:

350 P-47 fighters on the outeard route as far as Emden, and to meet the bombers on their return at the at the Dutch-German border;

1 group P-38 aircraft to protect the bombers over the target.

On 11 January for the bombing of Oschersheim, Halberstadt, and Braunschweig:

49 P-51 Fighters to protect the bombers over the target;

251 11 P-47 fighter groups for escort and to meet the returning bombers at points 50-60 miles before target;

2 P-38 fighter groups to meet the bombers on return route 50 miles before the target;

6 Spitfire fighter groups to meet the returning bombers in the Schelde River estuary area. Altogether approximately 1 000 fighter aircraft were committed to protect the participating bombers in this operation alone.

The German fighter forces in action on 11 January 1944 comprised a total of 239 single- and twin-engine fighters;

The German fighter forces committed on 20 February 1944 against the force of 1 000 4-engine bombers dispatched to bomb aircraft works in the Braunschweig-Leipzig area

251 comprised a total of only 362 single- and twin-engine aircraft, of which only 155 actually entered combat because of weather difficulties. These had to contend against a total Allied commitment of

13 groups of P-47 fighters, 2 groups of P-38 fighters, and 2 groups of P-51 fighters, or 765 US escort fighters plus

16 British squadrons of Spitfire and Mustang fighters or 350 fighter aircraft of the Royal Air Force.

The results of German fighter defense activities on 20 February 1944 were as follows:

Enemy losses: 27 bombers, 8 fighters

German losses: 28 fighters completely destroyed

21 fighters with more than 60 percent damage.

In major operations during the "Big Week," 20-26 February 1944 the US Eighth Army Air Force committed a total of 3 300 aircraft, the Fifteenth Air Force a total of 500, all of the 4-engine bomber type. The fighters committed to escort these bombers totalled 2 548 from the Eighth and 413 from the Fifteenth Air Force, plus 712 from the Ninth Air Force for close range escort.

On 12 May 1944 the US Eighth Army Air Force opened the Oil Offensive by dispatching 935 4-engine bombers to attack hydrogenation works in Central Germany, while the fighters committed in support totalled 1200.

252 The VIII US Fighter Command at that time had 7 P-51 groups, 4 P-38 groups, and 4 P-47 groups, in addition to which the US Eighth Army Air Force and the Royal Air Force committed units to protect the bombers along the outward and home routes.

As a rule the ~~the~~ Ninth Army Air Force "loaned" its 3 groups of P-38, and 2 groups of P-51, aircraft to the Eighth Army Air Force to escort bomners on their long-range strategic missions.

On 21 June 1944 the Eighth Army Air Force assigned 1150 fighters to escort 1400 4-engine bombers dispatched to attack industrial targets in the Berlin and Posen areas and hydrogenation works in Central Germany. In this operation 65 P-51 fighters escorted 142 B-17 Fortress bombers on their continued route to the Russian airfield at Poltava, Ukraine, over 1 600 miles from their take-off bases in England.

By taking fighter units from the tactical air forces for the purposes, fighter escort strengths of up to 1 400 aircraft were achieved in strategic operations of the US
253 Eighth Army Air Force alone in 1944.

In combined operations by the Eighth and Fifteenth Army Air Forces against targets in the German interior, escort fighter strengths frequently exceeded 2 000 aircraft.

253 In contrast, the effective fighter strengths available in Germany for the defense on 5 September 1944 totalled:

I Fighter Corps: 339 single-, 93 twin-engine, 7 Me 163/aircrft
Third Air Fleet: 281 " - -
620 single-, 93 twin-engine, 7 Me 163/aircraft

The above figures show that in 1944 the Allies committed escort fighters which outnumbered the fighters available to the German defense by three to one, and frequently were even more than the number of bombers they were to escort.

In September 1944 the Eighth Army Air Force had completed reequipping its 4 groups of P-38 with P-51 aircraft, and in October the bulk of its P-47 groups also received P-51 aircraft.

In December 1944 all groups of the US VIII Fighter Command had P-51 Mustang aircraft, with the exception of the 56th Group, which retained its P-47 fighters. The overall strength of the Command in fighter aircraft was thus

14 P-51 groups
1 P-47 group,

with up to ninety aircraft per group.

In summarizing, the following can be said of developments in the American fighter escort system so far as numerical strengths and operating range were concerned:

a. The fighter strengths available for long-range strategic mission increased in the winter of 1943-44

254 because of the following measures taken:

The number of fighter units assigned was doubled;

Group strengths were doubled;

British and American tactical fighter units were used to protect strategic bomber forces on their outward and home routes.

The escort fighters assigned always outnumbered the defending German fighters by two or three to one;

b. Introduction of the P-51 Mustang fighter from the beginning of 1944 on made it possible to provide effective escort protection over the target to be bombed. From May 1944 on, the later model of the P-51 becoming available enabled the fighter escort forces to cover the entire area in which 4.engine bombers operated.

c. From the autumn of 1944 on the majority of all long-range fighter units had P-51 aircraft;

d. The P-51 fighter was superior in every respect to the German Me-109 and FW-190 aircraft;

e. The rapid and comprehensive development of the American fighter escort system to protect 4-engine bomber forces, both in respect to performances and operating ranges and numerical strength, was the decisively important requirement for a systematic and logical conduct of strategic air warfare against Germany in daytime operations.[106]

106. Source 26; Study 158-160 Volumes I-IV; Study 164, Volume [illegible].

255

B. DEVELOPMENT OF ESCORT FIGHTER TACTICS

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(1) The Fighter Escort System. While the possibilities open to the command to provide escort protection for the Us strategic bomber forces were still limited by the numerical strength in fighters available and operating range considerations, it was necessary for reasons of safety and economy to adhere to the principle of restricting their action in performance of their escorting mission to the close vicinity of the escorted bombers. This meant that the fighters were under no circumstances allowed to proceed farther from their escorted bombers than was necessary in action to repel a direct fighter attack against any of the bombers. Under no circumstances were they to pursue an enemy fighter after it had been repelled in order to destroy it.

This corresponded precisely to the German pattern of direct escort protection mission of German single- and twin-engine fighters during the Battle for Britain in 1940.

The arrival at the end of 1943 and the beginning of 1944 of groups of P-38 and P-51 fighters with an operating range which for the first time permitted escort missions in operations against targets as distant as Kiel, Bremen, and Ludwigshafen, and the progressively increasing fighter strengths becoming available brought about a fundamental

255 change in the tactics of fighter units assigned to escort strategic bomber forces:

Fighter group commanders now received orders to pursue and destroy German fighters.

The purpose of these new offensive tactics was to support the strategic plan of destroying German air power as an essential condition for the Allied invasion in the west: energetic com at action against the German fighter arm was to accelerate the collapse of the German Air Force and its surporting industries.

Another experiment was made towards the end of January 1944 in this looser system of fighter escort protection by dispatching a fighter group flying on a very wide frontage, as what might be called a fighter screen, to attack and scatter the German fighter forces while these were still maneuvering into formation for defensive action. Initially this system, designated the Zemke system after its propagator, Group Commander Colonel Zemke, proved too vulnerable to attack by numerically superior German fighter forces. It did point the way, however, for the evolution of an improved system of "fighter screen" tactics employed later with great success.

When the German fighters changed to the tactics of avoiding fighter escorted bomber forces and confining their attacks exclusively to bombers operating far distant from

256 fighters which could protect them, the American fighter forces resolutely adopted a system of large-area roving mission operations, patrolling the whole of the approach and return routes area and seizing every opportunity to destroy German fighters in air combat or, by means of low-altitude attack, on the ground.

This system of tactics was introduced on 5 April 1944, when an operation was launched with only fighters participating: flying on a wide frontage 150 American fighters penetrated from north Germany through to southern Germany for the purpose of compelling the German fighter forces to take to the air. However, the German command detected that no bombers were participating in this operation and therefore did not commit its fighters. The US fighters thereupon descended from the altitude of 30 000 feet for low-altitudes attacks against the German fighters on their airfields.

The outcome was that a large number of German fighters were destroyed on airfields at Salzwedel, Hanover, Magdeburg, Brandenburg, Stuttgart, Memmingen, Augsburg, and Munich--an impressive demonstration of the striking power of the US fighter arm.

From then on it became standard practice in all strategic attacks against targets in areas where Germany still had control for the US escort fighters, unless they were

engaged in combat against "erman fighters, to carry out low-level attacks against airfields and traffic targets of all types, in order then to return to high altitudes for the purpose of escorting the bombers on their home route.

Three basic forms of tactics evolved for the execution of fighter escort missions:

a. The Mission of Close or Direct Escort-Protection. Under this system the assigned fighters received orders to remain constantly within sight of the bombers they wer escorting until it left the danger zone;

b. The Mission of Large-Area or Indirect Escort Protection. This method was usually applied when the bombers committed in an operation left their base areas in small units, or when the bomber force after reaching enemy territory split up into a number of smaller units to attack a number of targets;

For the fighters the mission of large area or indirect escort protection implied that they were to patrol those areas which the bombers would fly through or where they would do their bombing.

In this form of escort the fighters could also be ahead of the bomber force or on its flanks, to intercept "erman fighters before they reached the vicinity of the bomber approach route, the target area, or the return

258 route;

c. Combined Direct and Indirect Escort Protection.

The indirect and direct escort systems were applied in combination when a large bomber force left its bases in close formation, penetrated far over enemy territory, and there split up for attacks against various targets. When these targets were widely separated, or otherwise in the case of far distant targets, fighter protection had to be provided throughout the areas as a precautionary measure. The limited number of escort fighter aircraft available made it impossible to assign close or direct escorts to each bomber unit attacking the various targets in such operations. Direct escort fighters were therefor provided only while the whole bomber force was flying in a single formation during the approach and/or return route.

(2) The Relay Escort System.

(2) The necessity for fighters on direct escort missions to fly an irregular course above the slower bombers seriously reduced their penetration range. In order to fully exploit the penetration range of fighter units it was therefore essential to arrange a careful fighter escort relay plan. This system consisted of a schedule by which the first echelon of escort fughters would meet the bomber force as close to enemy territory as the bomb-

259 bombers could proceed with relative safety. This point the fighters reached by the most direct route from their bases, and from there accompanied the bomber force on the route towards the target.

Approximately five minutes before the first fighter echelon reached the limit of its penetration range, the second echelon arrived to relieve it, also flying to this point by the shortest route from its bases. If the distance of the target and the penetration range of the fighters made this necessary, a third fighter echelon was sent forward to relieve the second echelon, to be relieved later by the fourth echelon, etc.

The same relay system was arranged for the return route.

Each escort fighter echelon could execute its mission for a distance of approximately 140-190 miles, so that that a relieving echelon had to arrive each hour, and this had to continue until the bombers were out of the danger zones and over friendly territory on their way back to their bases.

This system presented extracrdinarily difficult problems for the US fighter forces. Whereas each bomber had its special navigation officer and special navigational instruments, all the fighter pilot had to go

259 by in finding his route was what he had been able to memorize and compute before his take off, plus a map and a few notes, frequently written in ink on the back of his hand. Each bomber had two pilots, supported by an automatic pilot device, whereas the fighter pilot had to fly his plane alone, do his own navigation, and keep a sharp lookout in all directions for German fighters, frequently had to engage in combat repeatedly on his long route, had to carry out low-level attacks, and then again had to steer his way to his home base, all the time under a considerable strain.

All of this required extremely careful planning and preparation for each such mission, and the highest conceivable qualifications in the pilots.

In view of the extreme difficulty of these missions it is only natural that failures happened occasionally. Thus, it happened at times that weather or other conditions compelled the bombers to depart from the preplanned route, so that a relieving echelon of fighters arrived at the prearranged meeting point to find no bombers in sight. Frequently the fighter pilots had to rely on blind navigation and naturally deviated from their course if the wind data provided before the take off was not accurate. In other cases they became

260 involved in combat before reaching the point of meeting with the bombers and were unable to break off the engagement and reassemble in unit formation in time.

In spite of all these difficulties, however, it can bestated that, with a few exceptions, the fighter escort relay system functioned well, and that it speaks volumes for the excellent abilities of the American fighter pilots.

261 (3) Escort Fighter Tactics for Low-Level Attacks against Airfields. When going over to an attack against airfields the escort fighters proceeded in accordance with a special system designed to secure the advantage of surprise and largely eliminate the hazards of antiaircraft fire.

Some distance from the airfield to be attacked, the attacking fighter unit, usually a group, would come down to a low altitude on a course set for the target airfield. Roughly a mile (1-2 kilometers) before reaching the target, at some salient terrain feature determined upon beforehand, the unit then climbed sharply to approximately 1 000 feet. One squadron continued to climb and then circled above the target airfield at between 3 300 and 3 900 feet to provide cover against German fighters. The second squadron then flew in to attack firing positions on the ground, while the

261 third squadron attacked the airfield installations and aircraft on the ground. After this the second squadron took the place of the first squadron, which came down to attack targest which had missed attack by the second and third squadrons. In response from an order given by the unit commander the whole unit then left the area to reassemble at some easily recognizable terrain point.

(4) Flight formation during the Execution of Escort Missions. As was the case with the Royal Air Force, the American fighter forces retained the basic tactical unit of a 4-aircraft flight. The squadron usually contained

262 6 flights of 4 aircraft each, the group between 2 and 5 squadrons. According to its current mission, the squadron subdivided into sub-units of 2 X 12 or 3 X 8 aircraft.

With the increasing penetration range of fighters, and particularly when units were committed in indirect escort missions, spacing from aircraft to aircraft increased from 300 to 750 yards. This was to decrease the physical strain on pilots flying in unit formation and increase their possibility for all around observation.

In the execution of direct escort missions, the fighter group flew in one of two basic formations:

a. Group of Three Squadrons.

One squadron cruised approximately 6 800 yards

262 ahead of and slightly higher than the main body to prevent attacks against the bombers f om the front;

One squadron ~~squadron~~ cruised about 1600-1600 feet above the bomber force;

One squadron cruised about 1650-2300 feet above the bomb-force.

b. Group of three squadrons.

One squadron cruised approximately 8 800 yards ahead of and slightly higher than the bomber force to prevent attacks against the bombers from the front;

One squadron patrolled the flanks of the bomber force, approximately 500-1000 feet higher than the bombers, a half-squadron on the right, a half squadron on the left;

One squadron patrolled the flanks of the bomber force, as above, but 1000-1650 feet higher than the bombers.

263 These tactical dispositions proved so satisfactory that they were retained right up to the end of the war.

(5) Data furnished to Escort Fighters concerning Stations of German Fighters.

(a) In the autumn of 1943 American fighter pilots still had no experience in combat against German fighters. To give them some advantages in fighter drives into enemy terrain, the US Eighth Army Air Force therefore estab-

established what was called the Y Information Service.

The service comprised an organization to monitor German fighter voice radio communications, which were conducted under what was called the Y (Ypsilon) system, to determine their positions, and to so process the information thus obtained that it could give the American fighters on the positions, stations, and intentions of the German fighters.

At a later juncture, this organization frequently enabled the command to direct fighter units committed in large area roving patrol escort missions to the concentration points of German fighters. Arriving at these points while the German fighters were still climbing to combat altitudes and therefore at a disadvantage, the American fighter units frequently succeeded in so scattering them that they were unable to attack the American bombers in unit formation or to attack at all.

(b) For close-range operations along the Franco-Belgian Channel coastline, use was also made of the British "Type 16" radio intercept system to guide US fighters to the German fighter units. This British system also was arranged to intercept voice radio communications of the (who used their Fu-G-16 transceivers for the purpose) German fighters and to establish their positions.

264 (c) An American so-called Microwave Early Warning system had been established along the east coast of England. Operating at a range of 150 miles, this system could establish the position of German fighters and report them to the US fighter forces.

In November 1944 the aircraft locating stations of this system were transferred to Gulpen, Holland, from where they were able to detect German fighters concentrating at points as far distant as a line from Mannheim to Kassel to Osnabrueck. This aircraft detecting system cooperated with the Y Information Service and provided the US fighters with exceedingly valuable information on the movements of German fighter forces. Quite frequently the information thus received enable US fighters to take German fighters by surprise from an advantageous position and thus achieve outstanding results.

On the whole the Anglo-American tactics and techniques for fighter escort operations protecting strategic bomber forces during daytime missions developed into a highly perfected system . This system excellently served its purpose of enabling the strategic bombing forces to accomplish their mission without interference by German fighters and furthermore gave fighters opportunities to take direct

264 action with weapons fire against targets in the German rear areas and in the German interior.

The average loss rates in bombers were at all times kept to a level low enough to justify continuation of the strategic bombing missions.

Due to their superiority in numbers, position, and technical performances, over the German fighter forces, the Allied escort fighter forces always suffered only very small losses.[107]

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107. Sources 26, 29; "Radar," a Report on Science at War, Government Printing Office, 1945 (USA), p. 33.

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4. The US Strategic Bomber Forces.

A. NUMERICAL STRENGTH MOVEMENTS

In the winter of 1943-44 the build up of the US Eighth Army Air Force in England made rapid progress.

The endeavor to build up large numerical strengths was basically in line with American views, since the achievement of the strategic objective hinged primarily upon the results to be obtained by massed bombings under the unit simultaneous bomb release (Bombenteppich) system, and upon the maintenance of a sustained air offensive against the German armament potentials.

On 5 September 1943 the VIII US Bomber Command in England had available

3 bomber wings containing
16 groups of B-17 aircraft
4 groups of B-24 aircraft.

The average strength committed by the VIII Bomber Command per operation in September 1943 was 310 4-engine bombers.

The largest force dispatched on a mission during the month comprised 407 4-engine bombersin an operation on 6 September.

In October 1943 the average size of forces committed by the VIII Bomber Command was 346 4-engine bombers.

The rapidly mounting numerical strengths had made it

267 necessary to expand the wings to form divisions. The 1st Bomber Wing had become the 1st Bomber Division, the 2d Bomber Wing was now the 2d Bomber Division, and the 4th Bomber Wing had become the 3d Bomber Division.

The largest operation of the VIII Bomber Command in November was that by 566 4-engine bombers on 3 November. In December already a record figures was reached in attacks on 16 and 30 of that month, with 710 4-engine bombers committed on each of these two days.

Compared with the strength figures for 5 September 1943, the strength available to the US VIII Bomber Command on 6 March 1944 showed an increase by 14 bomber groups. The bomber command now had the

1st Bomber Division, containing 12 groups of B-17 Fortress aircraft

2d Bomber Division, containing 11 groups of of B-24 Liberator aircraft

3d Bomber Division, containing 11 groups of B-17 Fortress aircraft.

For the operation against Munich on 18 March 1944 the US Eighth Army Air Force committed 800 4-engine bombers and 1100 escort fighters, thus establishing a new record.

On 1 October 1944 the US VIII Bomber Command reached its peak strength of 39 bomber groups, namely, 26 groups of B-17, and 13 groups of B-24 aircraft.

268 Already in May 1944 the VIII Bomber Command reached attack strengths of 1 000 4-engine bombers, and in July 1944 attacks occurred in which 1 400 4. engine bombers participated. [108]

In the southern, Mediterranean Theater of Operations, the US Twelvth Air Force was responsible for the conduct of strategic and tactical air warfare in 1943.

In October 1943 recommendations were submitted to consolidate the six ~~xxixxixmx~~ strategic bomber groups under a separate air force headquarters, the US Fifteenth Army Air Force, and separate them from the Twelvth Air Force. It was hoped that this arrangement would produce the following advantages after seizure of the Italian airfields:

a. Operating from Italian bases, the bombers could attack targets in the eastern territories of Germany, in Poland, and in Czechoslovakia;

b. Synchronized attacks from south and west would serve to scatter and weaken the German defenses;

c. Units operating from bases in England could take advantage of the more favorable weather conditions in the south for their landing and thereby outmaneuver the German defenses. The same system could be applied the other way around;

d. With bases so widely separated for air warfare

268 against Germany there was no possibility that unfavorable weather conditions could prevent the operations of both air forces at any given time. This would make a ceaseless conduct of strategic air operations against Germany possible

On 1 November 1943 Headquarters, US Fifteenth Army Air Force was established with a strength of six 4-engine bomber groups and two escort fighter groups, and placed under command by General Eisenhower. Plans were announced simultaneously to build the new air force up to a strength of 21 bomber groups, 7 fighter groups, and 1 reconnaissance group by 31 March 1944.

On 1 January 1944 Headquarters, US Theater Air Forces was established to coordinate the operations of the Eighth and Fifteenth Air Forces.

The strategic objective here was, primarily through integrated action by the Eighth and Fifteenth Army Air Forces in strategic air warfare against Germany, to achieve that degree of destruction of the German military potential, and particularly of German air power, which was considered as the essential condition for the invasion in the west.

In addition, the strategic air units of the Fifteenth Air Force were to be available to the US Air Command in Italy

269 if necessary for priority missions against targets in Italy until the airfields in the area of Rome were brought under Allied control.

On 15 June 1944 the US Fifteenth Army Air Force had the following strategic air forces:

One bomber wing containing six groups of B-17 Fortress aircraft

Four bomber wings containing fifteen groups of B-24 Liberator aircraft

One fighter wing containing

3 groups of P-38 Lightning aircraft
3 " " P-51 Mustang "
1 " " P-47 Thunderbolt "

Owing to the lack of escort fighter units with the required penetration range, operational action by the 4-engine bomber units of the Fifteenth Army Air Force against targets

270 in the German interior and Austria gained momentum more slowly than had been hoped.

In a dramatic debut on 2 November 1943, one day after its establishment, the Fifteenth Army Air Force dispatched a force of 74 B-17 and 38 B-24 bombers to bomb the Messerschmitt Works at Wiener-Neustadt. The units took off from airfields in North Africa and after a flight of almost 800 miles (1280 kilometers) delivered a total of 327 tons of bombs on a number of industrial targets in Wiener-Neustadt.

270 Strong German fighter forces and heavy antiaircraft fire brought down eleven of the bombers participating.

Owing to continuous bad weather and to th inadequate equipment of its units for blind bombing, the Fifteenth Army Air Force from then on had to confine itself to strategic attacks against industrial targets in northern Italy.

In January 1944 the strategic units of the Fifteenth Army Air Force were committed primarily against ground targets at the front in Italy, and a large part of their time was taken up with preparations for their displacement from North Africa to the new air base at Foggia, besides operations in preparation for the landing at Anzio, which took place on 22 January 1944.

Apart f om a minor operation by units of the Fifteenth Army Air Force against aircraft works at Klagenfurth on 31 January, the first case of integrated strategic action by the Eighth and Fifteenth Army Air Forces was in operations forming part of the major air offensive against German aircraft factories in the Big Week, from 20-26 February.

Operations by units of the Fifteenth Army Air Force in this offensive included the bombing of the Messerschmitt Works at Regensburg by 118 4-engine bombers on 22 February, the bombing of the steel roller mills at Steyr by 102 bombers on 25 February, the bombing of the Daimler-Puch

271 Works at Steyr on 24 February by 87 bombers under escort by 146 P-38 and P-47 fighters, and a repeated bombing of the Messerschmitt works at Regensburg by 176 bombers on 25 February.

The size of the forces committed by the Eighth Army Air Force was approximately four time that of the commitments by the Fifteenth.

On 27 February the critical ground situation in Italy made it necessary to order the Fifteenth Army Air Force to give action at the land front in Italy priority.

For this reason and because of a lack of Pathfinder units and long-range escort fighter forces, it was April before strategic units of the Fifteenth Army Air Force with the special mission of destroying the oil producing installations at Ploesti again participated in coordinated air operations over Europe.

On 5 May the Fifteenth Army Air Force dispatched its hitherto largest force of 620 4-engine bombers, carrying a total load of 1586 tons of bombs, to attack Ploesti.

On 30 June 1944 the Fifteenth Army Air Force had a total strength of 1200 4-engine bombers, and this figure was maintained up to the end of the war.

At the same time the Eighth Air Force had 2 100

272 4-engine bombers.

This total strength of 3 300 4-engine bombers available in the two US air forces in Europe in June 1944 represented a power potential which made it possible to conduct mass bombing attacks in any desired concentration, provided air supremacy was achieved over German territories.

This power potential was applied logically in strategic air warfare against Germany, so logically, in fact, that it came as a complete surprise to the German command when the 4-engine units of the Eighth Army Air Force only twelve days after commencement of the invasion in the west ceased their direct support action at the invasion front and resumed their strategic operations against the German armament industries.

Already on 18 June 1944 1 000 bombers of the air force, escorted by strong fighter units, penetrated over Germany, where the defenses had been almost completely stripped of fighters for transfer to the invasion front, and attacked hydrogenation works, and traffic targets in and at Hamburg, Bremen, Wesermuende, and Hanover, losing only elevel bombers in the entire operation.

Since the US Army Air Forces now had absolute and uncontested air supremacy over the territories of Germany, all conditions could now be considered to exist for the conduct of air warfare in the sense of the theories propounded

273 by Douhet in the form of ceaseless mass bombings in order to achieve results which would determine the outcome of the entire war.[109]

B.OPERATIONAL TACTICS AND TECHNIQUES

After the heavy losses inflicted by German fighters on the units committed by the US Eighth Army Air Force on 14 October 1943 to bomn Schweinfurt, the American command had changed its immediate strategic objective in that, pending the availability of adequate numbers of long-range escort fighters, 4-engine bombers were only to attack targets within the penetration range of available escort fighters, or at which it was to be anticipated that they would not encounter strong German defense fighters because of weather conditions.

The increasing penetration range of escort fighters made it possible to increase the scope of the strategic objective progressively.

It was therefore necessary for the 4-engine forces to execute their bombing missions in concentrated formations, organized in a manner which would make it easy for the limited number of fighters available to keep them properly under observation.

In view of the decisive extent to which the whole execution of bombing missions as part of strategic warfare

109. Impact 10/44;Study 164,Vol.IV; The AAF,Vol.III,pp.25-27,280, 398.

depended on the penetration range of the escort fighters, a crucially important point in planning for each operation was to keep the time from the moment the bombers entered to the moment they departed from zones defended by German fighters ~~antiaircraft~~ fire as short as possible. On the other hand any detour would increase the distance to be travelled and thus reduce the penetration range of the escort fighters.

These circumstances explain why, other than was the case with the Royal Air Force, the plans for operations by the US strategic air forces were so very uncomplicated, and why even the diversionary maneuvers by training units over the North Sea, a regular feature of US operational plans up to October 1943, were discontinued.

The necessity to reach the point of juncture with the escort fighters in close order and at combat altitudes, made it necessary for the 4-engine bomber units of the US Eighth Army Air Force to carry out lengthy assembly maneuvers over Britain. Apparently the units thus assembling were under no radio restrictions. For this reason the German Radio Intercept Service could at any time obtain a clear picture of the units participating and of how far the assembly of the force had progressed right up to the moment when they reported their departure.

275 The German defense was therefore never taken by surprise by operations of the US Eighth Army Air Force. The first stages of the concentration of units for an operation were known to it as early as two or three hours before the attack force started on its route, and frequently it was possible with the long-range search instruments in position along the coast of Holland to detect the units even in the final stage of assembly and to track them uninterruptedly.

Operations by the Eighth Air Force were not accompanied by interference measures to eliminate the German radar instruments of the Aircraft Reporting Service, so that German defense action was not hampered by any uncertainty concerning the current air situation or by any difficulties arising from such uncertainty.

275 In the matter of the selection of outward and home routes for forces operating against targets within Germany the Eighth Army Air Force developed certain principles which it retained without any changes throughout:

a. Forces dispatched to attack targets in the northern areas of Germany followed a route across the coast of Holland (Zuider See), or across the North Sea to cross the coast in the Weser River mouth or Elbe River mouth areas, or by way of Jutland;

b. The approach route for units attacking targets

275 in the western or central parts of Germans was usually by way of the mouth of the Schelde River;

c. Targets in the southern parts of Germany were usually approached by way of the mouth of the Somme River;

d. On their way to their home bases after an attack, the units always followed the route which took them out of the operating range of German defense fighters most quickly.

With its increased strength in 4-engine bombers and having escort fighters with increased penetration ranges, the Eighth Army Air Force in January 1944 introduced some changes in its methods. After penetrating over German territory, a force would now split up for attacks against various targets. After the attacks, the various sub-units reassembled to return to the bases in one compact force, or the three bomber divisions were committed individually by separate routes and at separate times, to attack separate targets. This served to scatter the German defense fighter defense effort, and in order to further increase complications for the German defense, attacks by units of the Eighth Army Air Force from the west were synchronized with attacks by units of the Fifteenth Army Air Force from the south whenever weather conditions permitted.

275 The following two examples clearly illustrate the special features evident in operational planning by the US Army Air Forces for strategic air warfare in Europe:

a. Bombing of Bremen by Units of the US Eighth Army Air Force on 20 December 1943.

Assembly of Units: Participating	Commencement at : 0830 hours	546 4-engine bombers plus 12 Pathfinder planes.
Time of Departure	: 1030 "	From Norwich area in three echelons on east course
Approach	:	Across coast of Holland between Vlieland and Amsterdam-Zuider See-Bremen
Bomb release	: 1143-1225	Over Bremen, by 472 4-engine bombers
Home Route	: Same as approach on wide frontage	
Met by Fighter Escorts	: In Vechta-Emmerich area.	

b. Synchronized Operation by Units of Eighth and Fifteenth Army Air Forces on 24 February 1944:

Eighth Air Force:

aa. 0943-1056: 60 B-26 Marauders, with fighter escorts, attack Gilze Rijen airfield

bb. 0957-1055: 60 B-26 Marauders, with fighter escort, attack Deelen airfield

cc. 0957-1048: 60 B-26 Marauders, with fighter escort attack Leeuwarden airfield.

276 The purpose of these attacks was to so damage three important German night fighter bases was to complicate German night fighter action against an Royal Air Force attack against Schweinfurth planned for the same night, and at the same time to engage the German daytime fighters in Holland and thus prevent their action against the main US attack;

dd. Approximately 1000 hours: Departure of 223 4-engine bombers, without fighter escort, from the Norwich area. This force was detected flying northeast 70 miles west of Texel at 1016, and was tracked on its course across the southern parts of the North Sea, to cross the coast in the areas between Esbjerg and Husum to Kieler Bucht, where it separated into two forces, 100 bombers attacking Rostock, and 10s attacking Gnesen/Poland.

After executing their bombing mission the two forces departed on anorthwest course across the west areas of the Baltic Sea, Esbjerg/Sylt.

ee. Departure of a force of 378 4-engine nombers, with fighter escort, from the Norwich area at 1109, which crossed the coast of Holland between Texel and den Haag, and then proceeded on a southeast course

to cross over Muenster/Rheine into the areas of Nordhausen, Erfurth, Schweinfurt, and Kassel.

239 bombers attacked Gotha, while 238 delivered 574.3 tons of demolition and incendiary bombs on targets in Schweinfurt.

Both forces returned on a northwest course c ossing the coast at 1530 hours between the mouth of the Schelde River and Berck sur Marne.

Fifteenth Army Air Force:

A force of 87 4-engine bombers dispatched from the Foggia airfield in Italy was detected at 1123 hours in the Split, Yugoslavia, area and then bombed Steyr. Returning by the same course the bombers were met along the route by 146 P-38 and P-47 fighters.

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For the German Fighter Command defense action against an operation such as that of 20 December 1943 was far less complicated than action against the operation of 24 February 1944. This applies both to the direction of such defense action and to the possibility to concentrate the necessary fighter forces.

On 20 December 1943 202 single- and twin-engine fighters took off from the fighter divisions stationed at Deelen, Stade, and Berlin, for concentrated commitment against the

penetrating enemy bomber forces. These fighter units shot down 35 4-engine bombers and 3 fighters, against 10 German fighters downed.

German fighter defense action on 24 February 1944 was as follows:

a. No fighter action was taken against the 2-engine force of bombers, since the Radio Intercept Service had already reported the concentration of 4-engine bombers from the Eighth US Army Air Force. Furthermore, fighters were stationed at only two of the airfields in Holland, namely at Volkel and Venlo, and experience showed that the only brief penetrations by twin-engine medium bombers did not appear a serious enough threat to these fighters to require their take off;

b. Against the force of 4-engine bombers approaching from the North, the German Fighter Command committed all units of the 1st Fighter Division, Berlin, and some units of the 2d Fighter Division, Stade, dispatching them in the direction of Luebecker Bucht, besides a few night fighters committed in Jutland, the Greifswald area, and Stettin;

c. The force approaching Gotha and Schweinfurt was met by single- and twin-engine fighters from the 2d Fighter Division, Stade, and from the 3d Fighter

279 Division, Deelen. Some of these fighter groups succeeded in approaching unescorted bomber units, the others were engaged in combat by the enemy escort fighters;

d. The force dispatched by the US Fifteenth Army Air Force to bomb Steyr was encountered by the fighter units of the 7th Fighter Division, Schleissheim, and of Fighter Command Austria, Vienna.

This German fighter action differed considerably from that anticipated by the US Southern Theater Air Forces Command in planning for the overall operation. It had been assumed that the entire German strength in defense fighters would be concentrated against the largest force penetrating, namely, the 477 4-engine bombers from the US Eighth Army Air Force approaching Gotha and Schweinfurt, and that the other two 4-engine bomber forces would escape fighter attack. For this reason all escort fighter units available were assigned to protect the main bomber force from the Eighth Army Air Force.

The German fighter commitment was based on completely different tactical and technical viewpoints.

The command logically had to first concern itself with the northern bomber force, since this was the first large force of 4-engine bombers taking off on a course across the North Sea.

280 Unless this enemy movement could be considered from the startas a diversionary maneuver, and the Radio Intercept Service furnished relatively precise data to the contary, the Fighter Command had to order its units to take off against it at the latest when the bomber force changed to a southeast course which could mean an attack against such points as Bremen, Emden, Wilhelmshaven, etc., and while there was still enough time for the defense fighters to reach combat altitudes before any such target could be reached by the bomber force.

For the above reasons it was categorically essential to order the take off of units stationed in the northern parts of the 2d Fi hter Division zone, namely, the 1st Group of the 11th Fighter Wing and the 2d Group of the 3d Fighter Wing, at Husum and Totenburg, respectively, plus the 3d Group from Ludwigslust as the most favorably situated group of the 1st Fi hter Division, Berlin, as soon as the enemy bomber forces crossed over the East Fresian Islands on an eastward course.

German defense reaction probably would have been different if the main enemy force, that dispatch against Gotha and Schweinfurt, had taken off first, and had been detected approaching the mouth of the Schelde River area. As actually happened in such cases frequently, the fighter units in the northern parts of the 2d Division zone in such case would

281 very have had to take off early for action against a force penetrating over the Schelde River mouth area.

If the northern bomber force had then departed from England one hour later, it would no longer have been possible for the German command to redirect the units of its 2d and 1st Fighter Divisions already committed against the force in the Schelde River mouth area.

Similar circumstances determined the decision taken by the German command for fighter action against the US Fifteenth Air Force bombers approaching from the south.

This bomber force was detected on a northward course in the Split area already at a time when the main bomber force of the US Eighth Army Air Force from England was still over the English Channel on a course set for the mouth of the Schelde River.

The only logical decision which could be taken was thus to commit the fighter forces stationed in southern Germany and Austria for action against the bomber force approaching from the south.

In view of the current overall air situation the action taken on the German side does not constitute a scattering of the defense effort. In a defense area of such wide dimensions as Germany and Austria together the principle of power concentration for defense had to be disregarded when its

281 application would have left a large area containing highly important defense targets without protection against a heavy attack.

Planning for this American strategic operation shows how dangerous it can be to use a specifically assumed reaction by the enemy for the choice of ones own tactical measures. The cost of the false assumption in this case is expressed by the losses incurred in the overall operation:

The Eighth Army Air Force lost 44 4-engine bombers and 10 escort fighters, the Fifteenth Army Air Force 17 4-engine bombers, and that a total of 61 bombers, or 7.7 percent of the entire number committed was lost in addition to the 10 fighters. The operation was too costly to be considered a complete success.[110]

282 From April 1944 on the two US air forces had such large numbers of P-51 and P-38 long-range escort fighters available, that they were able to completely neutralize the German fighter defenses whenever and wherever they desired by a crushing superiority in numbers and technical performances. In practice this gave the US air forces air superiority in all areas of operations, and operations from then on are marked by the following features:

a. Bombers penetrated over German territory in one or a number of forces to separate at a specified initial

point there into a number of units to attack a number of separate targets. After executing the bombing mission, however, the units reassembled for the home route:

b. This subdivision of the large force into sub-units was determined by

the strategic object aimed at in the current operation and

the local situation in the target areas involved.

During one period, for example, in which the highest priority was on agtion against the German fuel industries, efforts were always made to have one large operation, frequently involving synchronized attacks by units from the Eighth and Fifteenth Army Air Forces, strike all hydrogenation works within an overall large area, such as Central Germany and Czechoslovakia. At the same time sub-units would attack targets in the next priority category within the same overall large area.

283 On 24 August 1944, for example, 1 500 4-engine bombers plus fighter escorts bombed the hydrogenation works at Leuna, Bruex, and Freital, as well as numerous works of the automobile and aircraft manufacturing industries, while 600 4-engine bombers of the Fifteenth Army Air Force at the same time attacked with bombs the Hochhammer and Odertal hydrogenation works in Silesia.

110. Source 29; Study 158-160, Volumes II, III; The AAF Volume [illegible].

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c. The escorting fighter forces flew in together with the major bomber force, also in close formation, and protected the whole area of operations by means of roving missions while the Bomber force separated for the bombing of the various targets, after which the various fighter units reassembled to escort the entire bomber force on its home route.

Direct bomber-fighter voice radio communications were so well organized that a report by any bomber that German fighters were approaching or attacking brought escort fighters to the scene within a very short space of time;

d. Owing to the superiority of their escort fighters the losses incurred by the US strategic air forces from the spring of 1944 on were so insignificant that no necessity existed any longer for special maneuvering to lessen the effectiveness or completely escape German defense fighter action.

On the contrary, efforts were made whenever the opportunity offered to engage the German fighters in combat in order to wear them down;

e. The only limitations on operations by the units of the Eighth and Fifteenth US Army Air Forces were those

284 which weather conditions could produce at the take-off and landing airfields. It was only on very rare occasions that cloud covers extending as high as 23 000 feet in the areas of operations necessitated the cessation of current operations.

If the target area was concealed by a closed cloud cover it always contained a number of targets, which were specified in the operational plan, which the bombers could easily identify with their H2X instruments for blind bombing;

f. If one or the other of the sub-units found it impossible to bombs its assigned targets, either with H2X or visual sighting, it bombed chance targets on its homeward route. The result here was that all parts of the overall large area over which the bombers might pass had to remain under air alert until the last enemy bomber had left the areas defended by the German Air Force. Since the American forces in major operations spent many hours over German territories, this meant a serious loss in German industrial output;

g. Shuttle Bombing. The purpose in shuttle bombing tactics, first applied on 2 June 1944, was to use airfields in Russia in order to reach targets, primarily works of the fuel and aircraft industries, which were

284 too far from bases in England and Italy for effective action. For this reason shuttle bombing operations usually involved attacks against targets in Poland and Rumania.

However, the support given by the Russians was not effective enough for large-scale and regular operations of this type.

The following shuttle-bombing operations were carried out:

aa. By Units of the US Eighth Army Air Force.

(1) On 21 June 1944 114 B-17 and 70 P-51 aircraft attacked the Ruhland hydrogenation works and then landed at Poltava airfield in Russia. The whole unit while on the ground came under attack in the night of 21-22 June by bombers of the German IV Air Corps, committed on the eastern front, which destroyed 43 B-17 and 15 P-51 aircraft, and damaged another 26 B-17 aircraft.

On 26 June 71 B-17 bombers and 55 P-51 fighters took off from Poltava airfield and, after attacking the Drohobycz hydrogenation works in Poland proceeded to Italy, where the force participated on 3 July in operations by the Fifteenth Army Air Force against oil and traffic targets in Hungary and Yugoslavia. On 5 July

285 the force returned from Italy to its bases in England, attacking Beziers, in France, on the way;

(2) On 6 August another force, this time 76 B-17 bombers and 64 P-51 fighters, landed at Poltave airfield after attacking the Focke-Wulf Aircraft Works at Gydnia. On 7 August the force attacked the oil refineries at Trzbinia, in Poland, without incurring any losses. On 8 August it departed for Italy, bombing airfields in Rumania on the way, and from Italy returned to its bases in England.

(3) On 11 September the Eighth Army Air Force launched its last shuttle-bombing operation involving a landing in Russia. In this case 75 B-17 bombers and 64 P-51 fighters attacked an industrial target at Chemnitz in Saxony, and then landed at Poltava. On 13 September the force bombed the steel works at Diosgyör, in Hungary, and then landed in Italy.

At this time the landing fields in Russia were no

286 longer [illegible] of very much use, since the advance of Allied troops in the west and south had made enough airfields available which were close enough to all targets in the territories still under German control for effective air action.

286 bb. US Fifteenth Army Air Force:

(1) On 2 June 1944 the Fifteenth Army Air Force initiated the long-planned shuttle-bombing system, which included landings in Russia, by dispatching a force of 130 4-engine bombers escorted by 70 P-51 fighters to attack the rail center of Debrecen, in Hungary, and then land in Russia, on airfields specially prepared for US air forces at Poltava, Mirgorod, and Piryatin, in Ukraine.

After delays due to unfavorable weather the force took off from the Russian bases on 6 June and attacked Galatz airfield in Rumania instead of the originally planned attack against Mielec, in Poland, and then returned to its Russian airfields.

In support of the invasion in the west on 6 June, the force was to exert psychological pressure on Germany by constituting a threat from the east; the force was to remain in Russia for some time, although weather conditions there prevented further operations.

Finally, the force returned to its Italian base on 11 June without having attacked its originally assigned target, Mielec. On its way to Italy it attacked Focsani airfield in Rumania.

(2) On 22 July 1944 US Southern Theater Air Force Headquarters, in spite of the unfortunate outcome of

287 the operation by units of the Eighth Army Air Force on 21 June, dispatched a fighter-bomber force of 76 P-38 Lightning aircraft escorted by 58 P-51 Mustang fighters to attack airfields in Rumania while 495 4-engine bombers bombed the Ploesti oil center. The fighter-bomber force landed on airfields in Russia, the 4-engine bomber force returned to Italy.

On 25 July the Ffighter-bomber force attacked Mielec airfield, in Poland, destroying seven German aircraft on the ground.

On the next day it returned to Italy, again attacking airfields in Rumania on its way;

(3) On 4, 5, and 6 August 1944 a fighter-bomber force of P-38 Lightning aircraft carried out a number of shuttle-bombing missions between Italian and Russian airfields, attacking traffic targets and airfields in Rumania as direct support for the Russian offensive on the ground.

The use of fighter-bombers in the shuttle-bombing system then ceased. The ratio of expenditure to results achieved had proved it too costly.

h. <u>The "Double Blow" System</u>. A highly effective American system, but one seldom employed by the US air forces, was that of the "double blow." The basic idea here was for US units

288 to attack a target during daylight, and for the Royal Air Force to follow up by an attack against the same target during the night. The advantage for the Royal Air Force was that fires still burning from the daylight attack facilitated the identification of targets at night.

The first operation of this type occurred on 22 February 1944, as part of the Big Week pattern, when units of the Eighth Army Air Force attacked ball bearing works at Schweinfurt during daylight, which Royal Air Force units followed up by two attacks during the night.

The most dramatic case of combined operations of this type was that of the operation against Dresden, in which 773 4-engine bombers of the Royal Air Force bombed the city during the night of 13-14 February 1944, followed by 311 B-17 bombers of the US Eighth Army Air Force attacking on the next forenoon. On 15 February Dresden again came under attack, this time as an alternate target, by 210 B-17 aircraft of the US Eighth Army Air Force using blind bombing methods. This last attack caused the heaviest losses among the civilian population incurred in any city throughout World War II.

i. Triple Attack Tactics. This system was employed by both the US air forces and the Royal Air Force only in July 1944.

The tactical idea was to attack one and the same

288 target on three successive days or night in order to achieve exceptionally telling results.

The Eighth Army Air Force, for example, carried out a triple-blow operation against Munich on 11-13 July, the Royal Air Force one against Stuttgart on the nights of 24-25, 25-26, and 26-27 July.

Obviously the results achieved were smaller than had been expected, so that operations of this type were not repeated;

k. The 4-Engine Bomber as a Guided Missile. In order to obtain maximum results in the bombing of special category small targets, the US air forces developed the idea of filling worn out 4-engine bombers with explosive charges and using them as remote-control missiles. After a normal take off the pilot was to parachute to the ground as soon as the "Mother" bomber had taken over remote control. Following successful experiments and tests, a total of eleven such operations were launched late in 1944, primarily against Helligoland and the hydrogenation works at Heide and Oldenburg.

The B-17 aircraft used for this purpose were loaded each with three tons of high explosives in blocks measuring 280 by 420 by 120 millimeters. The remote control instruments were mounted in Mosquito aircraft, identifiable by their

389 red tail assembly. The missile aircraft was guided by means of the three-way pilot system . The missile aircraft flew at an altitude of approximately 500 feet, the controlling Mosquito at an altitude of about 660 to 1 000 feet. P-38 fighters flew escort about 6 600 feet up.

In the operation against Oldenburg on 1 January 1945 German antiaircraft fire brought down two of the missile aircraft. On the whole the aiming accuracy proved unsatisfactory, and after failure of the attack against Oldenburg on 1 January no more operations with remote-control bombs occurred. The Western Allies also feared that the German side, having numerous old bombers on hand and beinf short of pilots and fuel might adopt the plan for use against themselves. These anxieties were fully justified: at the end of 1944 the German Air Force commenced using Type Ju-88 bombers for the purpose. Under the German system the bomber was filled with explosives, flown by a Le-109 or FW-190 fighter clipped to its top and aimed at the target in a dive attack. Releasing the bomber at this point, the fighter then returned to its base. The units thus used were known as the composite aircraft (Mucke-Pack) of the 66th Bomber Wing.

In summarizing it can be said that after establishment

290 of air supremacy over all German territories American tactics and techniques showed only relatively small changes. The essential principl was one of mass bombings in the form unit simultaneous bom releases (Bomberteppich), for which purpose a specific number of aircraft were frequently assigned until they had achieved the desired degree of destruction.

At all times efforts were made to achieve precision bombing with visual sighting. If weather conditions precluded such bombings, their large radius of action at all times enabled the US strategic air forces to select targets for blind bombing in any area, which could then be taken under attack with blind bombing tactics and techniques developed to an extremely high stage of perfection.[111]

111. Sources 29, 73, 74; Study 164, Volume IV, The AAF, Volume III, pp. 7,314-315,727-728.

291 5. American Navigation Equipment.

A. BOMBERS

In the matter of radio equipment for their aircraft committed in the European Theater of War, the American air forces adopted the fundamental viewpoint that use should be made primarily of British instruments in order to fit the American units into the British system of air traffic control and navigation.

The first aircraft to receive British special navigation Equipment of the Gee (Hyperbola navigation) type were the B-24 bombers of a special purposes squadron of the US Eighth Army Air Force. At the end of 1942 these aircraft received their new equipment to enable them to execute their special mission of carrying out individual aircraft blind-bombing attacks against targets in western industrial regions of Germany under conditions of a 10/10 cloud cover. The purpose of these "moling missions", as they were called, was to keep the German defenses alerted and unsettled at times when the operating aircraft were adequately protected by weather conditions against German fighter attack and too accurate anti-aircraft fire.

Operations of this type commenced on 2 January 1943. Most of the attacks failed however, because the weather in the

291 areas of action was not unfavorable enough to prevent German defense action, so that the attacking aircraft had to break off their mission and return too soon to their bases. Operations of this type ceased altogether in March 1943, since the results achieved in bombing by individual aircraft without visual sight of the target were entirely disproportionate to the disadvantage which the risk involved that the German side might in this way secure specimens of the most up-to-date navigational instruments and develop methods of interference with their fuctioning.

Nevertheless, the operations served the purpose of familiarizing US strategic units with the functioning of the Gee navigational instruments. The performances achieved with the instrument were convincing, and all American 4-engine bombers from then on received them as standard equipment.

Operational experience had shown that the Gee system was a valuable aid for large area navigation but was not adequate for precise point navigation, which was necessary for blind bombing operations.

The opinions expressed on the British Oboe (Boomerang) instrument were more favorable. This instrument was far more precise, but had a limited range. The Royal Air Force had grave fears that this instrument, if used by the American units, might fall into enemy hands, and that the enemy would

292 develop methods of interference before a large enough number of the instruments could be installed in British night bombers to insure effective results.

On 11 March 1943 the Royal Air Force and the US Eighth Army Air Force reached an agreement that American bombers would not use Oboe instruments when on daytime missions.

293 The American forces for this reason turned their attention to the British H2S (Rotterdam) navigational and target locating instrument, and reached an agreement with the Royal Air Force that this instrument was to be made available to the US Army Air Forces and was to be copied in American factories.

In 1943 the US strategic air forces initially only had Gee instruments as standard equipment for large area navigation. In the autumn of the same year the units received H2X (Meddo) instruments, the American version of the British H2S (Rotterdam). American blind bombing techniques at the time were based on these two instruments.

Initially, H2X equipment was installed in two aircraft of each bomber group. These two aircraft assumed the role of Pathfinders. By the end of 1944 78 percent of all 4-engine bombers of the US Eighth Army Air Force had such equipment.

The US Fifteenth Army Air Force organized its bombers in a Red and a Blue force. In the Red force each group had four aircraft with H2X equipment. The Red force was assigned

294 ann fighter escorts available, and was intended for all-weather operations, including blind bombing when necessary, against targets in Germany. Units of the Blue force were to rely on visual bombing and attack targets near their bases in Italy, for which purpose they required no fighter escorts. 112

Early in 1944 the American bomber units received an improved navigational instrument, a modification of the Gee instrument designated the Gee-H.

The new instrument functioned very similarly to the Oboe, the difference being that the initial transmission came from the aircraft and was received and reflected by the ground station on another frequency, and that the time-distance difference was computed on the aircraft and used to determine the exact distance. The system was known as the cat-and-mouse system.

An aircraft using the Gee-H instrument followed a semicircular course which intersected the target and had as its center the ground station, known as the range station. The position of the aircraft on this semicircular course could be checked on a special indicator known as the [redacted] cat.

When the transmitter on the aircraft was switched on, a second dial, the mouse, indicated the present position of the aircraft in relation to the initial point. [redacted]. The air carried navigator had specially pre-

294 compiled tables enabling him to use this data.

Flight time and course from the initial point to the bomb release point were carefully calculated prior to the take off and at the last moment were corrected to allow for wind and speed data obtained during flight.

The Gee-H system could be used to a distance of 200 miles from the range station. Prior to the invasion in the west it was used primarily by Pathfinder units controlling attacks by relatively small bomber forces against V-1 installations in the Channel coast areas (Operation Crossbow).

In the January-June 1944 period units of the US Eighth Army Air Force flew a total of 31 Gee-H controlled missions.

295 Following the invasion in the west, the use of Gee-H instruments by Pathfinder units was soon extended to include attacks against airfields, traffic centers, supply depots, and similar targets. Between 10 and 26 June 1944 units in the west flew approximately 3 000 bombing missions with Gee-H control, in some cases attacking as many as twenty targets simultaneously.

The whole system was further improved in mid-September by measures introduced to synchronize the bomb aiming devices at each control point with the existing ballistical bombing data.

295 In November 1944 a still futher improved navigational and target locating instrument was introduced. This was the Micro-H instrument, which operated on the 3-centimeter waveband and was therefore proof against German interference.

In its functioning this new instrument in practice was merely an application of the Gee-H system to the H2X system.

After take off, the aircraft navigated by Gee-H data up to its initial point, approximately 35 miles before reaching the target. Here the navigator adjusted his H2X instruments to beacon reception. The indicator now received waves from two Micro-H stations, two transmitters established at Namur and Verdun and operating on different frequencies.

With the reading from his indicator and using specially compiled tables, the navigator could check his precise position in relation to the target and make the necessary corrections. The instrument included an attachment for the synchronization of the bomb aiming device as each control point was crossed.

The new instrument played a highly important role, since in the winter of 1944-1945 80 percent of all strategic bombing missions by units of the Eighth Army Air Force and 70 percent of those by units of the Fifteenth Army Air Force were blind bombing attacks.

112. The AAF, Volume II, pp. 262-3, 610, 690-692, Volume III, pp. 666 ff.

296 Although blind bombing was far less accurate than bombing with visual aiming, the Micro-H system was of inestimable value. Without it weather conditions would have made it impossible for weeks and even months at a time to attack targets the destruction of which was a matter of extreme strategic importance. In the case of the oil offensive, for example, blind bombing, even with poor results, was better than no bombing at all because of a lack of visual observation of the targets.[113]

In summarizing it can be stated that, due to their adaptation to the tried and tested British system plus very good developments of their, the American strategic bomber forces in Europe at all time had available the technical means necessary for the implementation of their strategic intentions.

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113. Sources 26, 58; The AAF, Volume III, pp. 666-668.

297 5. American Navigation Equipment.

B. FIGHTER AIRCRAFT.

297 In view of the tasks they had to perform in the execution of their escort missions, the radio equipment available to American fighter pilots in their aircraft was exceptionally simple!

For voice communications they had a very powerful ultra-shortwave transceiver. For navigational purposes they had a direct DF instrument functioning on the position line system with which they could steer by any transmitter of their own selection.

The training program for American fighter pilots included very thorough training in blind flight and instrument navigation, so that these personnel had all qualifications enabling them to solve the problems which might develop duing bad weather missions.

For the American strategic bomber forces it was a standing rule that they were to fly missions whenever weather predictions insured safe landing conditions on their return.

This meant that they might have to take off in conditions of a 10/10 cloud cover with a low cloud ceiling, if it could be predicted with certainty that the weather would improve by the time of their return many hourse later, for example, if it could be predicted that high fogs at their bases would

298 clear up or that the current bad weather front would have passed their base areas by the time of their return.

No special consideration was shown for the fighters. Just as was the case with bomber personnel, fighter pilots were expected to assemble in unit formation above a closed cloud cover and punctually reach the meeting point with the bombers. Pilots with experience in blind flying could do this without difficulty, since their target locating instruments enabled them to steer very precisely to a radio beacon or to the transmitter of the unit lead aircraft.

A more difficult problem was that of establishing a special air traffic control system for fighters. This system was an urgent necessity to insure the safe return of units which might lose their way through false orientation or because of technical failures of the ground control service.

Initially, British radar instruments operating on medium wavebands were made available to the American air foeces for these purposes. These were not satisfactory because their range was inadequate for the large area operations of the American units.

It was only in the summer of 1944 that the US Eighth Army Air Force succeeded in obtaining from USA a hand-made model of a radar instrument operating on centimeter

298 frequencies over a range of 200 miles with great precision, and capable of showing a fighter pair flying together as two separate blips on its screen as no other instrument could do.

Since the American strategic air forces always executed their missions at great altitudes they were able to exploit fully the range of this instrument, which operated on the line of vision principle.

After excellent results obtained in test operations, the entire system for the control of fighters during strategic operations by units of the US Eighth Army Air Force was based on its use. This fighter control system supported the fighter units with navigational data in the execution of their missions, that of escorting bomber forces, and guided them to German fighter units, whose movements the instrument also tracked constantly.

The performances of American fighter pilots in mastering the techniques of bad weather operations and of blind navigation over long distances were of a very high standard. Cases in which fighters and bombers failed to meet at the appointed meeting points were very rare. With so few technical aids at their disposal, it was primarily the high quality of their training which enabled American fighter pilots to execute

299 their unparalleled and difficult tactical missions.[114]

114. Sources 16, 20, 29, 76; "Radar," A Report on Science at War, p. 34, US Government Printing Office, 1945.

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PART III

BRIEF REVIEW OF THE OUTCOME OF ANGLO-AMERICAN STRATEGIC AIR WARFARE AGAINST GERMANY

1. The Results of British Night Attacks. There can be no denying that the Royal Air Force with its tactical and technical means and methods from 1942 on succeeded in maintaining sustained strategic air warfare on a considerable scale against the German war potential. At no time were the German defenses in any position to prevent it from executing its planned attack operations.

In a final review, however, the question presents itself whether the British system of large area bombing at night produced the desired results of direct and lasting damage to the German war potential. On this subject British General Fuller in his work "The Second World War", London, 1947, writes:

> Sixtyone towns, each with a population exceeding 100 000, or with a total population of 25 000 000, were bombed. The impact on morale, however, was precisely the opposite from that which Monsieur Douhet and his adherents had prophesied. Instead of coming quickly, the German collapse was painfully slow in coming.

Sir Arthur Harris, Chief of Staff of the British Bomber Command pronounced the following verdict in his work

301 "Bomber Offensive," London, 1947;

The concept that the main effect of the attacks would be the impact on morale proved completely false. After we had destroyed practically all major German cities the population was still untouched. Immediate results had not been expected, but it was known from experience in the Battle for Britain and the air attacks against towns in northern Italy what results the bombing of towns could have.

In his work "The Second World War," London, 1948, Professor Cyrill Falls writes as follows:

The bombing of cities was the plumpest, most brutal, and most devastating form of warfare, but its results nevertheless did not equal those which had been expected.

In an address before the International Committee of the Red Cross in Geneva in 1945, Falls expressed the following opinion:

In my opinion the gains of areal bombing were in no way commensurate with the costs and efforts expended on them. Dispassionate statistics prove that the impact on the military industry was far smaller than has been maintained and assumed. It did nothing to reduce the capabilities of the military industries until the victory was secured by the ground forces in the west and the

302 east.

Professor P. M. S. Blakett, physicist and Nobel prize winner, states as his opinion in his Work "Fear, War, and Atom Bombs," Zuerich, 1950:

> The nighttime bomber offensive of the Royal Air Force was an attempt to force the issue by the use of air power, without defeating the enemy ground forces. This attempt failed.....
>
> Notwithstanding the great development which air power had undergone, the German defeat was brought on primarily by the gigantic losses in troops and materiel in battles on the ground, just as had been the case in World War I.

In an article "The Objective in Warfare," London, 1953, British military writer B. H. Lidell Hart supports the following views:

> But even in a relatively favorable analysis it appears pretty certain that they (the Royal Air Force attacks against towns) played a less decisive role than the operations of the ground forces against targets of strategic importance in the military field. In any case, they did not decide the outcome of the war. Analyzing the entire war phase by phase it becomes evident that the results achieved lagged far behind the claims made

303 by those directing these actions.

In a review of Hans Rumpf: "Der Hochrote Hahn, die Zeit der grossen Feuerschlaege," Dr. Theo Weber writes as follows:

With a lack of flexibility almost unparalelled in military History, the Bomber Command for three whole years hammered away at more than one hundred major and medium sized cities and towns, following precisely the same pattern in each case of burning down the historical center districts of the town.....

The end of the war showed the same picture in all cases of towns and cities stricken by air warfare: The central part of the town with its cultural and art institutions, its public buildings, and its densely populated residential districts had been levelled to the ground, the outlying districts with the industrial works had suffered relatively little damage or were not damaged at all.

A few examples are sufficient to authenticate what has been said above:

Bochum : More than 50 percent of all residential quarters destroyed. A large hall several hundred yards long of a steel roller works completely undamaged in the outskirts;

303 Duesseldorf: 243 air attacks destroyed more than one-half of all residential quarters. The Rheinmetall-Borsig Works with their 21000 employees and the no less important Schiess-Defries Works remained in operation up to the end of the war;

Frankfurt on Main : Air attacks completely destroyed 45 percent and damaged 25 percent of all living quarters. In the small town of Hoechst, only six miles distant, the giant complex of IG Farben factories as well as other industrial works remained undamaged;

Stuttgart : Air attacks destroyed more than 50 percent of all living quarters and 27 of the existing Protestant churches. Militarily important large factories, such as the Electron GmbH, Vereinigte Kugellager, Robert Bosch AG, and others were not hit at all or were only damaged.

Numerous medium and small towns which were of no military importance at all were either partly or completely destroyed.....

On the whole it can be said that the German industry in particularly those factories engaged in the manufacture of commodities of military importance, was almost completely intact at the time of the Allied invasion of France in the early summer of 1944.

This point is of importance insofar as two years had already passed by then since the British commenced

304 directing the full force of the air offensive against the German towns.....[116]

The above quotations from various sources serve to show that experience proved that the British principle of areal bombing of large industrial towns at night was completely unsuited to achieve the strategic objectives of air warfare, namely, the essential degree of destruction of the German military potential .

116. Source 78.

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2. The Effects of American Daylight Attacks. In contrast with the British concept of indirectly striking Germany's military potential by means of areal bombing attacks against large industrial towns, the purpose in the American conduct of strategic air warfare, from the outset and adhered to steadfastly throughout the war, was to launch direct attacks against militarily important targets, and to secure favorable chances for a number of completely destructive full hits by committing large numbers of bombers in such attacks. The viewpoint of the American air forces was that this concept could only be materialized by means of daytime complete unit attacks, employing the tactics of simultaneous unit bomb release (Bomben-teppich).

The accurate placing of bombs on a target depended largely on the possibility for unimpeded visual aiming during the bombing.

This accuracy, it was felt, could not be achieved by means of electronic aiming equipment.

The ratio of hits on or near the target to the overall number of bombs released is shown in the following table compiled on the results achieved by the US 4-engine bomber units.

306

Date	Target	Bombs Used			Full Hits	Near Hits
		Number	Tons	Type (caliber in pounds)		
1943						
Aug 24	Villacoublay Airfield	1 018	257	500	89	25
Dec 31	CAM Ball-bearing Works Paris	753	188	500	12	9
1944						
Apr 5	SNCASE, Toulouse	694	174	500	15	11
Feb 20	Erla Heiterblick	460	115	500	39	30
May 29	" "	306	76	500	7	3
Jul 7	Motoren Tauche	823	206	500	84	24
	ATS, Leipzig	626	131	500	3	-
Feb 9	Gustloff, Weimar	2278	569	500	78	7

The above figures show that in the American system of simultaneous unit release bombing (Bombenteppich) the ratio of effective hits achieved was less than 10 percent of the total number of bombs delivered in the target area.[117]

To examine the problem of to what extent this percentage was adequate to achieve a decisive degree of destruction of the target attacked, two categories of targets will be used here which served primarily as targets for American strategic daytime attacks, namely,

factories engaged in the manufacture of aircraft and fuel producing or processing installations.

117. Source 31.

306 a. Aircraft Manufacture. In a Special Supplies and Procurement Services conference on 25 August 1943, Field Marshal Milch, responsible for the direction of German air armament production, stated that it was to be assumed that the air attacks against the aircraft factories in Wiener-Neustadt, Regensburg, Warnemuende, and Oschersleben would lessen output by 25 percent.[118]

In a Special Supplies and Procurement Services conference on 23 February 1944, Field Marshal Milch stated as follows:

> It is a known fact to us that we have come into a difficult position since July of last year (1943). At that time, in July, we had for the first time reached a monthly output exceeding 1 000 single- plus 150-200 twin-engine daytime and night fighters. We were increasing our output vigorously and intended reaching a figure of 2 000 single- plus 250 twin-engine daytime and night fighters to be manufactured in November 1943. This we did not succeed in doing, instead, our efforts were thwarted in each case by heavy attack.
>
> Then, we were to achieve an output of 2 000 fighters in February 1944. Under no circumstances can we rely on this program. We can be happy if we achieve an output of around 1 000-1 200 fighters.....

118. Source 79.

307 I am forced to assume, however, that our output in March (1944), instead of reaching the 2 000 mark, will drop to a figure probably below 800.....[119]

At a conference of the Fighter Aircraft Production Staff on 4 March 1944 Field Marshal Milch stated:

Since July, (1943) the enemy are striking systematically at our industries, primarily at our manufacture of single- and twin-engine fighter aircraft. In a statement over the Daventry Broadcasting Station they themselves have boasted that they have completely destroyed fifty fighter aircraft factories. That figure is about correct when one considers that some works were attacked repeatedly....[120]

308 Form the above quotations it is clearly evident that the American daylight attacks with visual bombing of factories of the aircraft manufacturing industry had achieved a large measure of success and had reduced German air armaments by one-half of the authorized output in fighter aircraft. This, in turn, had a decisively important impact on the strengths available in fighter aircraft for defense against the American strategic bomber forces, the operations of which were protected by steadily increasing numbers of

119. Source 80.
120. Source 81.

308 escort fighters.

The resultant lack in fighter aircraft not only made it impossible to bring the existing German fighter units up to authorized strength or to replace all of their current losses in aircraft, but also precluded any possibility of appreciably increasing the size of the defending fighter forces by the activation of new units.

In these respects it is evident that the US air forces with their techniques of daylight attacks against German aircraft manufacturing works had not completely achieved the objective of destruction by the spring of 1944, but had achieved a noticeable and perhaps decisive degree of destruction in view of the fact that it was the serious lack of fighter aircraft for daylight defense purposes on the German side which gave the US air forces uncontested air superiority over the western German-occupied territories and over Italy from the spring of 1944 on. The results of the American attacks thus also contributed decisively towards the success of the Allied invasion in the west.

The fact that, in spite of continuous effective attacks by the American air forces against aircraft factories, the German fighter output increased steadily from the spring to the fall of 1944, reaching the record monthly figure of

310 2 875 Me-109 and FW-190 in September, and that 2 441 of these two types were manufactured even as late as in February 1945, was due exclusively to German measures taken to re-locate the industry in numerous small factories and in bomb-proof premises which could not be damaged by any type of bombing attack.[121]

In spite of these performances of the German industries, however, the German Air Force was unable to profit and was unable to build up a fighter arm strong enough to recover air siperiority over German territories from the American air forces. This, in turn, was due to the catastrophic reduction of the German output in fuels achieved by the US air forces by means of attacks forming part of the Oil Offensive, which commenced on 12 May 1944.

b. Fuel Production. The results of the Oil Offensive, which was carried primarily by strategic bomber units of the US Army Air Forces are illustrated clearly by the following table:

Month 1944	Total Output (in Tons)	Percent of Capacity
March	927 000	100
May	715 000	77
June	472 000	51
July	420 000	45
September	310 000	34
October	220 000	23
November	290	31

In March 1945. the German fuel output was still 17 000 tons, equal to 18 percent of the output in March 1944.

In the year from May 1944 to May 1945 the US Air Forces in Europehad directed a total of 432 attacks against 124 German fuel producing and processing works, while the Royal Air Force in the same period directed 125 attacks against 10 hydrogenation works located in the Ruhr region.

Altogether the American and British air forces delivered a total of 225 000 tons of bombs on installations engaged directly or indirectly in the production and/or processing of motor fuels. In these operations the Royal Air Force also showed a preference for daytime attacks.

This oil offensive was the decisively important contribution of air warfare towards the Allied victory, since it struck a vital artery on which the entire German armed forces had to depend mutually.

Oil targets were point targets, which could never have been struck decisively under the British concept of night attacks with areal bombing.

That the strategic objectove was achieved in this all-important offensive represents a triumph of the American concept , which can be formulated as follows:

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121. Sources 82, 83, 84, 85.

309 the strategic air forces will strike the most crucially important element of the enemy military potential by means of direct and continuous precision bombing attacks with the strongest possible forces until that element is completely and permanently eliminated.[122]

122. Source 78.

PART IV

SOURCES

311 The numbers in the right column, preceded by an "R" or an "S", are the numbers by which the sources quoted are designated in the compilation of material for the two studies on air defense.

Source	Title	
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2	British compilation "Milestones of Strategic Bombing," September 1939-20 April 1945	R 53
3	From Special Supplies and Procurement Services Conference Notes, 23 Nov 42: Oberstingenieur Schwencke concerning large bomber aircraft of the USA and Britain	R 673
4.	Factual report in "Wochenend" on Allied bombing Warfare	R 33
5	General von Renz (Retired): Compilation of most important events of the war, with dates--1 Sep 39-22 Nov 42.	R 0111
6	Dr Baumgart: From personal notes on air attack by Royal Air Force units against Wilhelmshaven on 18 Dec 39.	R 0123
7	Detail G2-West Reports, 1 Feb 44 : Royal Air Force tactics in night attacks	R 1360

312	Source	Title	
	8.	Churchill: The Second World War, Chapter XII: Development of the Royal Air Force Bomber Command	R 609
	9.	From Special Supplies and Procurement Service Conference Notes, 29 May 42: Oberstingenieur Schwenck concerning the British Hyperbola system	R 639
	10	Study by Luftwaffe General Staff, Branch 8: Developments in German Home Defense 1939-1944 (AAA) (Die Entwicklung der Reichsverteidigung 1939-1945--Flak)	R 190
	11	German Third Air Fleet After-Action Report for July 1941	R 1020
	12	As above for April, May, June 1941	R 1021
	13	As above for August, September, October 1941	R 1081
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	20	Compilation by Luftwaffe General Staff, Branch 8, June 1943: Radio and bomb sighting equipment in British 4-engine bombers	R 1140
	21	Action and experience report by Fighter Command Southern Germany for March 1943	R- 343
	22	Speicial Supplies and Procurement Services conference notes on present and possible future interference by Western Allies with German radar and navigational equipment	R 0232
	24	Excerpt from "Luftwaffe Ring," November 1955: Report by Briton Guy Gibson on preparation and execution of his attack with 18 Lancasters on the night of 16-17 May 1943 against the Moehne-, Eder-, and Sorpe-, River valley dams	R 1031
	25	"Wehrkunde," IV Year, Volume 9: Address by Professor Dr. R. V. Jones on natural and man-caused interferences with radar locating	R 1368
		Report by German General Rumpf (Retired) on air attacks on night of 16-17 May against the Eder and Sorpe River valley dams	R 1048

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	27	Luftwaffe Technical Office, 15 Mar 44: Report on Spitfire IX, P-51-B, P-38-H, and P-47-G Fighter Models	R 0369
314		Luftwaffe Operations Staff/G2 Compilation: Strengths of British, US, and French Air Forces in Europe on 1 Oct 43	R 1379
	29	By author of present manuscript from personal experience while CO, Fighter Command Holland/Ruhr Region in Aug 42-Nov 43, and CO, 3d Fighter Division in Deelen, in Nov 43-Apr 45	
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	34	From Special Supplies and Procurement Services conference notes 27 Nov 42: Concerning Electronic Aircraft Detecting Organization, its development and possibilities of interference; Development of electronic interference methods	R 1317
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	39	Report Dr. Rottgardt to Field Marshal Milch on 2 Aug 43 concerning output of Li-SN-2, wide-angle antennae, Li-C-1, Biene W, Pauke A, Lichtenstein radar fixed and wobble range waves	R 247

315	Source	Title	
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	49	From Special Supplies and Procurement Services conference notes, 14 Dec 43: Dr.Rottgardt concerning status of measure to suppress tinfoil interference	R 1351
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	58	Ibid, Report 1 Jan 45: Description of navigational methods used by Anglo-American air forces (Hyperbole, Long-range, Boomerang, Discus, and Micro-H)	R 1346
	59	From Special Supplies and Procurement Services conference notes, 14 Dec 43: Schwencke concerning bomb load capacities of Allied aircraft; new aircraft types; RAF use of uniform 4-engine bomber forces; Pathfinder tactics	R 1353

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318	Source	Title	
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	70	From Special Supplies and Procurement Services conference notes, 19 May 44: Electronics--Status May 1944, Measures against tinfoil interference	R 1286
	71	Reich Marshal Goering conference, 16 Nov 44: Radio and radar interference to complicate enemy target detecting; Training and techniques for all-weather fighter operations	R 1296
	72	Order by ~~XXXXXXXXXXXXXXXXXXX~~ Luftwaffe Operations Staff, 16 Feb 45, concerning AAA strengths to protect nine most important hydrogenation works	R 1255
	73	Ibid, 27 Aug 44, concerning reorganization of air warning system	R 1122
	74	Brief informational note from Chief, Technological Air Armaments, Luftwaffe High Command, 4 Jan 45, concerning enemy use of remote-control US 4-engine bombers with demolition charges on 1 Jan 45	R 1257
	75	Air Warfare in the West (Der Luftkrieg im Westen), a series of articles by M. Feuchter in Flugwehr und Technik	S 25
	76	Statements by US pilots on weather conditions for operations by 4-engine bomber and fighter forces	R 0289

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	77	"Der Bombenkrieg ueber Deutschland und seine Lehren," General Rumpf (Retired) (The War of Bombs over Germany and its Lessons)	R 1274
	78	A series of articles by Dr. Theo Weber, being a review of "Der hochrote Hahn, die Zeit der grossen Feuerschlaege", M.Rumpf (Fire and Fury,+ the Time of the Great Attacks with Fire)	R 1372
	79	From Special Supplies and Procurement Services conference notes, 25 Aug 43: Field Marshal Milch concerning impact of air attacks on fighter aircraft factories	R 286
	80	Ibid, 23 Feb 44: Field Marshal Milch concerning Anglo-American air attack and their impact on aircraft manufacture	R 1025
	81	Field Marshal Milch at first conference of Fighter Production Staff, 4 Mar 44	R 502
	82	Overall effective strengths of fighter forces --f om Quarterly Reports by Luftwaffe Chief of Sup and Admin, 1 Aug 28-31 Dec 44	R 303
	83	As above for twin-engine fighter forces	R 304
	84	As above for night fighter forces, 2 Nov 40-31 Dec 44	R 305
	85	Compilation by Branch 6, Luftwaffe Chief of Sup and Admin, 28 Jun 45: German aircraft production, by records from 1939-45, including newly manufactured, reconstructed, and repaired aircraft	R 707

+ Roter Hahn: Colloquial German for fire. "Ihm den Roten Hahn ins Dach setzen," for example, would mean to "set his house on fire."